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Co-operation at the Top

The foundry industry is well organized, both as to employer and research activities. The iron section has the Council of Ironfoundry Associations, and the British Cast Iron Research Association; steel has the British Steel Founders' Association and the British Steel Castings Research Association; and non-ferrous, the Association of Bronze and Brass Founders, the Light Metal Founders' Association, supporting directly or indirectly the British Non-Ferrous Metals Research Association. Moreover, there are numerous other important employers' associations covering special branches of iron-casting production. In France, there are but two bodies: the *Syndicat des Fondeurs* and the *Centre Technique des Industries de la Fonderie*, the former carrying many district and product divisions. Purely technical associations and institutes in most countries cover all phases of foundry science and practice.

We often hear the rationalists propound the notion that because many of the activities carried out by the employers' and research associations are either common or overlap, there should be at least closer co-operation if not amalgamation. They point to two recent conferences covering dust and fume problems in foundries. We attended both these successful conferences and state categorically that a joint conference would have failed to get such a wide cross-sectional picture of what is being done, why it is being done, and what the industry thinks of it. As it was, in both cases, much—and probably very pertinent—comment was left unsaid, owing to time limitations. As for the idea of amalgamation, that is impossible, not only because of methods of finance, but also because of lack of interest in each other's major problems; such an organization would be largely decorative.

There remains the solution of the problem of securing useful collaboration, yet there is already in being a large measure of co-operation. Only once, or perhaps twice at the most, has there been a meeting of the presidents of the foundry associations. This is a feature which should be resumed, and each organization should prepare notes as to where co-operation could produce the best results. Some subjects, such as the incidence of purchase tax, standards, and raw materials, are not of common interest; others, such as the requirements of the Factory Regulations, education, training, recruitment, costing, etc., are. We do not suggest that the presidents are necessarily specialists in every phase of activities undertaken by the bodies they head, but they are in a position to determine where and how, co-operation could be made most effective. Obviously every section of the industry has much to learn from the other branches.

Congress Paper Author

Dr. Borut Marincek, who is the Author of the official Swiss Exchange Paper—"Comparative Study of Melting Furnaces Used in Iron Foundries," printed on page 463 of this issue—was born at Trieste in 1915 and educated at Celje, Yugoslavia. After matriculating in 1933 he studied chemistry at the Technical University, Ljubljana, Yugoslavia, and gained a diploma in 1937. In the following year he did National Service in the army and was subsequently works engineer in Yugoslavia. In February, 1940, he went to Berlin and studied metallurgy at the technical university, Berlin Charlottenburg, where he gained the Dr.-Ing. Diploma. Dr. Marincek removed to Switzerland in 1943 to take up an appointment as technical manager at the pig-iron works of Roll's Iron Works, at Gerlafingen and was responsible for the increase in slag-wool production. From 1950 to 1954, he held the position of foundry manager at this company's works at Choindez near Delemont, and during this period was responsible for pig-iron casting, centrifugal-tube casting, and the electro pig-iron works. Since 1954 Dr. Marincek has been working independently in Zurich as an engineer and for the past twelve years has held the position of lecturer in metallurgy at the Federal Technical University, Zurich.

Shop Lighting Development

One of a number of interesting exhibits on the stand of the British Electrical Development Association (2, Savoy Hill, London, W.C.2) at the Fuel Efficiency Exhibition now running in Manchester, is of the Sargrove automatic artificial lighting control system. By this arrangement, which is best applied in new installations, the degree of illumination at one point in the factory is used photometrically to switch on the artificial lighting. Thereafter, the lights in other departments come on in a predetermined sequence which takes into account their relative daylight illumination. Perhaps more important from a fuel economy viewpoint is the fact that, when daylight improves, the sequence is reversed and artificial lighting is extinguished automatically.

Basic Materials Prices Steady

Prices of basic materials (excluding fuel) used in British industry showed little change in September, the Board of Trade's monthly index for the overall level (June 30, 1949 = 100), falling by 0.4 per cent. to 155.8 per cent. One of the commodities which increased during the month was copper, which showed a rise of 5.1 per cent.

Higher prices for most non-ferrous metals and their semi-manufactures, as well as for raw rubber, accounted for almost the whole of the rise in the indices for materials used in the mechanical engineering and electrical machinery industries; both continued their recent substantial upward movement with increases of 1.2 and 2.1 per cent., respectively, over the month.

Correspondence

To the Editor of the FOUNDRY TRADE JOURNAL

BOX NUMBERS

SIR,—I have taken the FOUNDRY TRADE JOURNAL for years now, and found it extremely interesting, as I have been foundry foreman, superintendent, and manager, in turn. With several associates, I have been very disappointed with the advertisers in your "Situations Vacant" columns. Only about 1 per cent. bother to answer letters. Surely it is only common courtesy to acknowledge a reply to an application for a position. There are many who would appreciate an acknowledgment; maybe you could suggest this to your advertisers. It would be a little more encouraging to the other side.—Yours, etc.,

"APPLICANT."

October 17, 1955.

[We have coined the *nom de plume* and have printed the letter because it is typical of many in similar vein.—EDITOR.]

Further correspondence appears on page 471

Dinners

INSTITUTION OF PRODUCTION ENGINEERS

The annual dinner of the Institution of Production Engineers was held at the Dorchester Hotel on October 12. Sir Leonard Lord presided. The guests of honour were General Sir Brian Robertson, G.C.B., and Mr. A. B. Waring. With them at the high table were: Major-General K. C. Appleyard; Dr. A. M. Ballantyne; the Hon. R. A. Balfour; Mr. A. B. Burman; Mr. G. Cubitt-Smith; Mr. Robert Douglas; Captain G. E. T. Eyston; F. W. Halliwell; K. J. Hume; Sir Godfrey Ince; R. E. Leakey; Major-General W. A. Lord; Mr. F. Nixon; Mr. H. P. Potts; the Rt. Hon. The Lord Sempill; Dr. Llewellyn Smith; and Mr. H. F. Spencer.

How to Last a Lifetime

This is the title of a satisfying leaflet published by the Royal Society for the Prevention of Accidents. Its distribution coincides with a campaign launched this week throughout the country. Tomorrow the Lord Mayor of London presides over a conference at Guildhall, London, where the Minister of Labour and National Service will give an address. Managements have taken up no fewer than 1,000,000 copies of this leaflet, which is written in simple language and illustrated by a dozen cartoons depicting preventable accidents. Readers desiring supplies of this leaflet should write to the publishers at 52, Grosvenor Gardens, London, S.W.1.

Machine Tool Exhibition

The International Machine Tool Exhibition, organized by the Machine Tool Trades Association from Victoria House, Southampton Row, London, W.C.1, is to be held at Olympia from June 22 to July 6 next year. Exhibits will include metalworking machine-tools and woodworking machinery, engineers' small tools, gauges and measuring equipment, testing equipment, presses, power hammers and heat-treatment plant. Countries to be represented, apart from Great Britain, include Belgium, France, Germany, Holland, Italy, the Scandinavian countries, Switzerland and the United States. The advance catalogue, 23,000 of which have been mailed to prospective visitors, includes a technical index in both English and French.

Comparative Study of Melting Furnaces used in Iron Foundries*

By Borut Marinček

The continuous increase in coal prices in comparison with the price of electricity, and the constantly higher requirements for the quality of the melted cast-iron justify the comparative review of melting furnaces in the iron foundry. This is particularly the case because of the probability, that also in future the calorific output of coal will become more expensive in proportion to the electrical calory. For this reason, the cold-blast cupola, the hot-blast cupola, the electric-arc furnace and induction furnace have been discussed and compared.

Neither the variety of the method of working of these furnaces nor the difference in the quality of the liquid cast-iron which has been produced in them, permit a direct and indisputable comparison. Nevertheless, the experiment was undertaken to discover through their advantages and disadvantages some point at which one or the other of the furnaces could come into consideration. In this respect the principal viewpoint has been how these furnaces can enter into the question as regards quality of the liquid iron, how they function in actual practice and which factors influence them economically.

Even at present—under certain special conditions—especially when great efficiency is required as to the quality of the liquid cast-iron, the induction furnace can come into favourable consideration for economic reasons, particularly in countries where the relation between the electrical calories and coal calories will be favourable for this furnace at present or in the near future.

Introduction

The melting plant is the heart of every foundry. As long as molten metal can flow regularly and without interruption to the casting point so the entire foundry can operate smoothly and efficiently. The economic efficiency of a foundry depends very much upon the method of melting the iron, first, because the cost of melting the metal is such a large item of the total expenditure and, second, because the cost of the final castings depends very largely on the quality of the molten metal used. For these reasons the melting process in the foundry may understandably be paid the closest attention.

Until comparatively recently iron was melted in the iron foundry wholly by the cold-blast cupola. In recent years, however, the hot-blast cupola especially, and also the electric furnaces have been introduced into ironfounding. While the employment of the hot-blast cupola has proved to have some definite advantages, particularly in the matter of iron quality, the use of electric furnaces in the foundry is still in dispute. In Switzerland the question of electric furnaces is of considerable importance owing to the relatively favourable price of electric power. In other countries, however, the rising price of coal is beginning to turn the scales more and more in favour of the electric furnace as a foundry-melting unit.

Changing Prices of the "Electric-Calorie" and the "Coal-Calorie"

If the total volume of electric power generated be examined it is evident that in recent times this has greatly expanded; and it is very clear that in countries where industry is well developed but where coal deposits are small (*e.g.*, Switzerland, Sweden, Italy, Austria, etc.) electrical power is progressively replacing the use of coal-generated power. The reason for this is primarily that electrical installations are ideally easy to regulate. At the same time the application of electric power in the place of coal is making further inroads into the metallurgical processes. Owing to the fact that high temperatures are easily obtained, and that, unlike coal, electric heating does not tend to contaminate the heated charge, the use of electric power in this field is advantageous.

However, although there are these advantages in the use of electric heating for metallurgical processes the installation of electric furnaces for this purpose is by no means standard practice. The reason lies primarily in the field of economics, partly in the regional variations in the price ratio of the electric-calorie and the coal-calorie. It is evident that to-day in certain areas the electric furnace is used for the production of ordinary mild-steels and grey-iron castings, (*e.g.*, in Switzerland and Italy) while in other countries furnaces fired with coal will be used for these purposes as a general rule. It appears, however, that those countries wherein the electric furnace is now widely employed have passed through a development which other

*Official Exchange Paper from the Swiss Foundrymen's Association communicated by the Dept. of Metallurgy of the *Eidgenossische Technische Hochschule* of Zurich, and presented at the International Foundry Congress 1955, organized by the Institute of British Foundrymen.

Comparative Study of Melting Furnaces

countries have yet to meet. This development has taken place owing to the almost universal tendency for electricity to become a cheaper source of power than power generated from coal. The increased use of electric furnaces in regions of relatively-cheap electric power is thus very interesting for it indicates that in a matter of a few years or a few decades the same kind of thing is likely to happen in countries which at present utilize the more usual melting methods.

For example, in Switzerland since the first world war, the Siemens Martin open-hearth furnaces have been progressively replaced by electric-arc furnaces and for the last ten years the common grades of steel have been produced by this means, a development which is now taking place in other countries. The last (air-blown) blast furnace in Switzerland was finally blown out in 1935 and replaced in 1943 by an electric low-shaft (Tysland-Hole) furnace. In several places now the electric-arc furnace has replaced the cupola for melting grey iron in the foundry. Before long a large induction-melting unit will be installed which will replace the cupola still further.

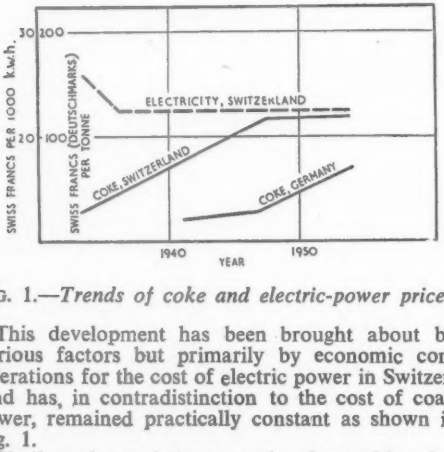

FIG. 1.—*Trends of coke and electric-power prices.*

This development has been brought about by various factors but primarily by economic considerations for the cost of electric power in Switzerland has, in contradistinction to the cost of coal-power, remained practically constant as shown in Fig. 1.

Similar price variations may be observed in other countries, *e.g.*, Germany (see Fig. 1). It can be confidently predicted that here also the cost of coal will increase in the future partly because owing to the present use of the better grades of coal the cost of extraction will always tend to rise as reserves are depleted and partly owing to the present tendency for wages and the wage-bill to increase all the time. Assuming things go on as at present it is only a question of time before the point is reached where electric power stands in so favourable an economic relationship with coal-generated power that the operation of an electric furnace becomes economically more favourable than the operation of a coal-fired unit.

Further, it is already established that the relative cost of electric power is becoming more favourable than the cost of coal because the thermal efficiency of steam-generating stations is continually improving (see Fig. 2),[1] and in the near future it can be expected that the use of atomically-generated electricity, which has already been shown to be no dearer than that generated in a coal-fired plant, will be greatly extended. Already in England large-scale atomic power plants are being put down which will produce electric power at a cost no greater than that generated in a modern steam-turbine coal-fired plant. It is to be expected therefore that the development of atomic power plants in the next decades will be of general benefit to the average cost of electric power.

Factors which Influence the Quality of Liquid Iron

The quality of molten cast-iron is difficult to define because it is dependent upon a number of very different, and in many cases not fully understood, factors. Some of these factors which are of importance during melting may be discussed here.

The pig-iron, which is similar in its analysis to cast-iron, is produced from iron ore by reduction with carbon. It consists of an alloy of iron which, on account of its high content of carbon and silicon in particular, possesses a very marked affinity for oxygen. If molten pig-iron or cast-iron comes into

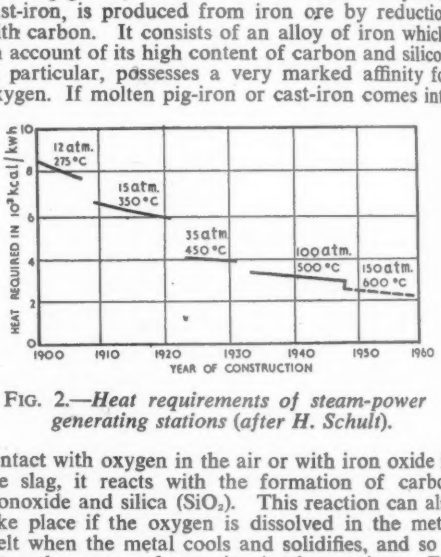

FIG. 2.—*Heat requirements of steam-power generating stations (after H. Schult).*

contact with oxygen in the air or with iron oxide in the slag, it reacts with the formation of carbon monoxide and silica (SiO_2). This reaction can also take place if the oxygen is dissolved in the metal melt when the metal cools and solidifies, and so is often the cause of porosity in the castings. For this reason therefore the molten pig-iron should come into contact as little as possible with atmospheric oxygen or with oxygen only weakly chemically-bonded in the form of an easily-reduced oxide.

The presence of oxygen in cast-iron, however, also raises the solubility of hydrogen, that is an iron high in oxygen content will under the same conditions hold a larger quantity of hydrogen in solution (see Fig. 3).[2] On solidification the hydrogen can also be given off and can also cause the formation of blowholes.

Oxygen, in addition, has an undesirable effect on the sulphur pick-up of cast-iron during the melting process, that is to say if the oxygen content of the iron is low and there is only a little iron oxide in the slag, *i.e.*, the conditions are reducing, then a low

sulphur-content results in the molten metal. Practical results have demonstrated how the desulphurization in a hot-blast cupola becomes less and less as the FeO content of the slag increases (see Fig. 4).[3]

It has also been observed in pig-iron furnaces that the sulphur content of the metal falls as the carbon and silicon contents increase, *i.e.*, the more reducing are the conditions in which the pig-iron is tapped. (See Fig. 5.)[4] It can also be found in cupola practice that in general when the carbon and silicon content of the iron falls, so the sulphur content rises.

The sulphur content of molten cast-iron has a considerable influence on the formation of oxide film on the surface. As the sulphur content rises, particularly into the region of about 0.1 per cent. S so the stability of the oxide film increases and this leads to the production of unsound and dirty castings. (See Fig. 6.)[5]

Further, the rising sulphur content of cast-iron can lower the surface tension of the molten material, and this can under certain conditions cause the generally undesirable growth of the graphite flakes.

The formation of oxide film can be countered by a high carbon-content or by a higher melting temperature. This adds to the importance of a sufficiently high temperature which is also necessary to ensure fluidity in the molten iron and ensure that sound castings are produced, particularly when these are thin-walled.

To sum up, it can be said that the quality of molten cast-iron is primarily governed by the oxygen and the sulphur contents and the temperature, factors which should be carefully controlled during the melting operation.

Melting in the Iron Foundry

In foundry furnaces the metal is merely melted and partially carburized. The conditions for a metallurgical treatment, in particular that of desulphurization, are seldom achieved in practice because this is accompanied by a considerable increase in the cost of melting.

The iron must be heated to a temperature of about 1,500 deg. C., which requires a heat input of about 320,000 kilocalories per *tonne*,[7] *i.e.*, about 370 kwh. per *tonne*, which must be covered either by the combustion of coal or by the consumption of electric power. In the cupola the fuel used is coke, which is burned in atmospheric oxygen to form carbon monoxide or carbon dioxide. The combustion gases leave the cupola as hot flue gases. The ash in the coke is fused and slagged with limestone and this, together with material, melted away from the cupola lining, forms the slag which floats on the top of the iron.

In the cold-blast cupola the heat from the coke has to cover the needs of heating and melting the iron and slag, the heat in the flue gases and the heat lost to the outside from the entire cupola. The combustion of the coke takes place in a stream of air moving sufficiently rapidly that a part of the carbon monoxide is converted to carbon dioxide which is an advantage in the matter of heat economy since this combustion of carbon to carbon dioxide produces about 3.5 times more heat than the combustion to carbon monoxide alone.

However, if attempts are made to produce a further combustion to CO_2 by raising the input of air, this will have a strongly oxidizing effect on the molten iron. A certain degree of oxidation of iron is found in normal cupola practice. Experience shows that in the cold-blast cupola the loss through oxidation during melting amounts to about 2 per cent. of the iron, about 12 per cent. of the silicon (at 2 per cent Si) and 20 per cent. of the manganese. The losses of silicon and manganese are dependent upon the initial concentration of these elements. Some 30 per cent. of the sulphur in the charge (most of the sulphur comes from the coke which contains about 1 per cent. of sulphur) passes into the metal, and therefore in cupola melting a sulphur pick-up must be reckoned with.

In the cold-blast cupola the normal coke-rate amounts to 150 kg. per *tonne* (*i.e.*, 15 per cent. or

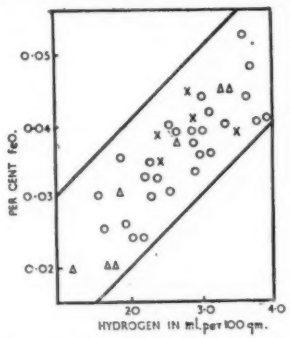

FIG. 3.—*Relationship between oxygen and hydrogen content in cast-iron (after S. Mazkawa).*

3 cwts. per ton) which brings about a sulphur pick-up of about 0.04 per cent. S in the iron. With the air entering the cupola, however, there comes also the moisture contained in the atmosphere and this comes into contact with the white-hot coke and the molten metal. Hence this water vapour is disrupted into hydrogen and carbon monoxide and therefore the iron dissolves more hydrogen the higher its oxygen content. (See Fig. 3.) If, for example, the air contains 10 gms. of moisture per cub. metre then over 15 cub. metres of hydrogen are passed up the cupola for every ton of iron melted, a quantity which in many instances is responsible for a bad casting.

An increase in temperature in the cold-blast cupola can be achieved either by increasing the coke charged or by raising the volume of the blast. The first leads to higher melting cost and an increase in the sulphur content of the iron. The second measure is undesirable on the grounds of iron quality, because owing to the extra oxygen the sulphur and hydrogen contents of the iron will be higher. It can be appreciated, therefore, that the greater combustion of carbon to carbon dioxide, which is certainly desirable on grounds of heat

economy, should be avoided if good quality iron is required, especially as such measures only raise the temperature of the iron by a small amount. The production of a hot iron from a cold-blast cupola is only possible under optimum conditions, primarily the use of high quality, large-sized coke.

In the hot-blast cupola, in contrast to the cold-blast cupola, a proportion of the heat required is supplied as hot blast. The advantage of this is that since this heat is derived from the hot waste-gases no extra fuel is required and this heat is not a source of contamination (as the coke is, for example).

In this manner, since a proportion of the necessary heat is supplied in the hot blast, the coke rate can be reduced to approximately 100 kg. per *tonne* (2 cwt. per ton) of iron made. At the same time since the blast volume is reduced, the heat losses in the

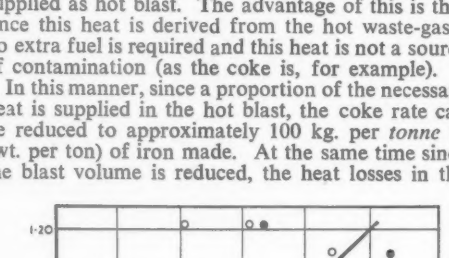

FIG. 4.—*Influence of degree of oxidation of the slag (iron content) on desulphurization in a hot-blast cupola (after Kootz and Rellermeyer); (a) Author's own results (b) results of E. Piwowarsky.*

waste gases are also smaller. By the application of hot blast a higher combustion temperature is generated and a hotter iron therefore results. At this higher temperature the coke in the cupola is converted more to carbon monoxide according to the well-known Boudouard equilibrium, that is to say the reduction ratio becomes more favourable. As a result the oxidation losses and the take-up of oxygen into the metal both become less. The iron loss in the hot-blast cupola is about 1 per cent., the silicon loss 0 to 3 per cent. and the manganese loss some 8 to 15 per cent. Resulting from the lower coke-consumption the total quantity of sulphur entering the cupola is less, thus the liquid iron only takes up sulphur to the extent of about 0.025 per cent. S. A further result of the smaller coke charge and the enhanced combustion to CO is that the blast volume is reduced and therefore the quantity of hydrogen derived from the moisture in the air is also less than that in the cold-blast cupola.

In the hot-blast cupola the temperature of the coke bed is higher and therefore a larger proportion of steel scrap can be included in the charge and converted to cast-iron. It is possible in fact to raise the working temperature to such an extent that not only can iron be melted wholly from a steel-scrap charge but in addition a reduction of silica or iron oxide can occur. Further, the operator of the hot-blast cupola is not dependent upon supplies of high-grade foundry coke to obtain a melting temperature, the cupola may be fired with ordinary grades of coke.

The liquid iron from the hot-blast cupola exhibits a number of prominent advantages compared with iron from a cold-blast unit, particularly in the matter of quality. Hot-blast iron is less oxidized, lower in sulphur and phosphorus content, and is produced at a higher temperature. The economic advantages of hot-blast operation are primarily those of lower coke-consumption and greater independence in the

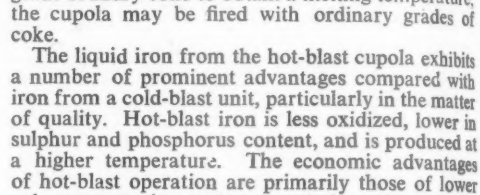

FIG. 5.—*Variation of sulphur content with carbon and silicon content according to equation:*

$$\log[S] = \frac{\text{per cent. } C + 0.1 \text{ per cent. } Si - 1.35}{0.168 \text{ per cent. } Si - 2.27}$$

The broken line at (a) shows the saturation limit for graphite at 1,500 deg. C. and at (b) that for graphite at 1,400 deg. C.

matter of size and quality of coke, lower melting loss of iron, silicon and manganese and the possibility of operating entirely on returns or on steel scrap (thus saving the cost of pig-iron). These factors are relevant for acid-lined cupolas only, the basic-lined cupola, on account of the expensive lining is seldom applied in practice.

For electric melting-furnaces the electric-arc furnace and the induction furnace take first places. Because the supply of heat to these furnaces is not dependent upon the consumption of a solid fuel there is much less contamination of the melted charge, that is to say the liquid metal, in contrast with the cupola-melted material is far less contaminated either with sulphur or with oxygen and hydro-

gen which have been blown through it. Oxygen can come into contact with the surface of the melt if this is not protected by slag, and hydrogen can enter as moisture in the charge. The great advantage of the electric melting-furnaces is their capacity to produce iron at a high temperature.

The electric-arc furnace is often used for the melting of cast-iron. Its principal advantage is the fact that it can be operated basically, which makes desulphurization possible among other things. A drawback of this type of furnace is that the melt is strongly overheated immediately beneath the three electrodes, and under these conditions the molten iron can pick up oxygen from the air, and in particular hydrogen from any damp and rusty scrap which may have been used in the charge, both of which may affect the quality of the iron. However, if the electric-arc furnace be so operated that these dangers cannot come into play (by avoiding the use of damp or rusty scrap in the charge and by keeping the metal covered with a slag) then provided that the operating costs are not too high, the electric-arc furnace can be most valuable for the melting of cast-iron.

In recent years the induction furnace has been progressively applied further to the melting of cast-iron. In this type of furnace the heat is developed actually in the material to be melted, and therefore areas of local overheating, such as are found in the electric-arc furnace, are not possible. Also there is the further advantage that, unlike the arc furnace, electrodes are not required. Since no air is required to generate the heat the molten metal is not oxidized by having air blown through it, nor is it contaminated with hydrogen from damp air. A scarcely noticeable degree of oxidation can only take place if the hot and clear surface of the melt is allowed to come into contact with air, and this can be prevented by the use of a slag as long as the agitation of the bath is not too pronounced. For these reasons the loss of oxidation or iron, silicon and manganese is practically negligible in the induction furnace and the control over the final chemical-analysis of the iron is thus very close, particularly as there is no sulphur pick-up taking place. The temperature of the liquid iron can be raised as required and by recarbonization the carbon content of steel scrap can be raised to any desired level.

The consumption of electric power for melting and heating cast-iron to 1,500 deg. C. is dependent upon the size of the furnace, and in the case of a 5-ton furnace, it amounts to 550 kwh. per *tonne* of metal. To superheat a *tonne* of molten cast-iron through 100 deg. C. requires some 40 to 50 kwh. To keep 1 *tonne* of cast-iron warm at a given temperature, say 1,500 deg. C. requires between 15 and 20 kwh. per hr. according to the size of the furnace.

This relatively low consumption of power for keeping the metal warm shows that the induction furnace is an economical unit for holding and mixing cast-iron, particularly as during this holding period the analysis of the iron can remain practically unchanged.

A comparison of the thermal efficiencies of the types of furnace considered here shows that in the electric furnace the efficiency is some 60 per cent., compared to 25 to 30 per cent. in the cold-blast cupola and 40 to 50 per cent. in the hot-blast cupola according to W. Patterson.[8] The comparative data for these different types of melting furnace have been gathered together and set out in Table I.

Melting Furnaces for Production

It is expected of a production melting furnace that it will provide molten iron of the correct analysis at the desired temperature in the right quantities and at an economical overall-cost. The first three of these points will now be discussed for different furnaces, the question of melting cost is considered in the next section.

In the cold-blast cupola an iron of any desired analysis cannot be melted, because sulphur pick-up makes the final metal carry at least 0.06 per cent. S and in most cases the final sulphur-content amounts to 0.1 per cent. S. Also it is difficult to melt a cast-iron with a particularly high carbon-content.

Only when the best quality coke is used is the iron temperature sufficiently hot for the metal to be used, for example to make thin-walled castings.

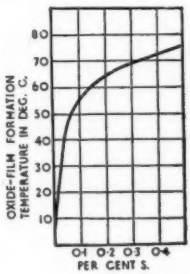

FIG. 6.—*Influence of sulphur on the temperature of oxide-film formation.*

As already explained, it is possible by raising either the coke rate or the blast volume to increase the temperature of the iron, but both these devices have their attendant disadvantages.

Because cupola melting is a continuous process the cupola must produce a given quantity of iron in a given interval of time. Every alteration in the loading of the cupola causes a variation in both the temperature and the analysis of the iron produced.

The necessity to vary the quantity of molten iron tapped in order to keep the melting unit running in step with the moulding shop can only be met to a limited extent when operating the cold-blast cupola without there being a variation in the quality of the metal produced. In an iron foundry it therefore often happens that operations are held up for lack of iron, or that there is too much iron available, for it is almost impossible to synchronize the demands of the moulders with the output of the cupola. Economically this is always bad, owing to the effects of dislocation on both the melting and the moulding operations.

Comparative Study of Melting Furnaces

Unfortunately, when the cupola is used for melting, there is practically no method whereby already-melted iron may be kept warm for any length of time.

Many of these disadvantages apply also to the hot-blast cupola. This unit, however, is more flexible with regard to analysis, since the sulphur content of the iron can be lower. The temperature of the iron is higher and can usually be raised enough to meet all demands, but, like the cold-blast cupola, it provides no means for keeping the metal hot once it has been melted, and being also a continuous process it can only produce so much iron in a given time, attempts to vary this usually having undesirable consequences.

On the other hand, it may be considered as an advantage in both the cold- and hot-blast cupolas that the coke bed exerts a self-regulating action on the carbon content of the metal, which is not the case, for example, in the electric-melting processes for obvious reasons.

The electric melting furnaces operate commercially as an alternative to the cupola. However, since for reasons already mentioned, the arc furnace is less used for melting cast-iron, the induction furnace will be discussed here, but the points considered also apply to the arc furnace.

The induction furnace operates in a discontinuous manner, the iron being fed and tapped in batches. A long-lasting melting operation is feasible if the iron is kept in a holding (induction) furnace which merely keeps the metal up to the desired temperature for a small expenditure of electric power (15 to 20 kwh. per ton per hour, according to furnace size). As this has scarcely any effect upon the analysis of the iron, any quantity of metal can be held for any length of time at the desired temperature, which is very useful for meeting the demands of the moulding shop, since moulds can be poured as soon as they are ready. In this case, therefore, the operation of the melting plant can proceed constantly in step with the operation of the moulding shop, and therefore undesirable interruptions in the latter can be avoided.

The composition of iron melted in the induction furnace can be kept within close limits. As there is no sulphur pick-up, so the sulphur content of the metal agrees closely with that of the charge. A close control of composition is possible since there is practically no loss due to oxidation.

The temperature of cast-iron melted in the induction furnace can be raised to a point high enough to make the metal sufficiently fluid for the production of thin-walled and small-size castings. A high fluidity is essential for this. The induction furnace is also excellent for the production of special cast-irons, *e.g.*, alloyed irons or irons with nodular graphite. In fact, it may be claimed that in every way the induction furnace is most suitable as a production furnace in the iron foundry.

Melting Costs

Since an industrial operation is governed very largely by the economics of the process, the cost of melting iron in the cold-blast and hot-blast cupolas and in the electric furnaces, particularly the induction furnace, must now be examined. As the foregoing will have made clear a direct comparison of the cost of the different melting methods is not possible because the quality of the iron from the different furnaces is not the same. Furthermore, raw-material prices vary considerably and these exert a very powerful influence on the profitability of the entire melting-process. The other important costs we have to consider are the losses, the fuel, and the capital charge of the plant. It may be assumed, however, that wages and the price of fuel are the same for all furnaces and thus local variations in these are cancelled out.

For furnaces operating on the same raw material, therefore, the melting loss, the cost of fuel, the amortization and the quality of the final product can all be compared.

In the cold-blast cupola (see Table I) the coke consumption is roughly 150 kg. per *tonne* (3 cwt. per ton) of iron melted, the iron loss is 2 per cent., the silicon loss about 12 per cent., and the manganese loss about 20 per cent. (*i.e.*, the degree of oxidation is considerable). Capital charges are very small, the temperature of the melted metal is not high, and the sulphur content of the iron rises during melting by about 0.04 per cent. S.

In the hot-blast cupola the conditions are rather more favourable (see Table I), as the coke consumption amounts to about 100 kg. per *tonne* (2 cwt. per ton), the iron loss is about 1 per cent., the silicon loss is from 0 to 3 per cent. and the manganese loss 8 to 15 per cent. (The degree of oxidation is thus small.) The capital charge is substantially higher than that for the cold-blast

TABLE I.—*Operating Characteristics of Melting Plants.*

	Cold-blast cupola.	Hot-blast cupola.	Induction furnace.
Scrap usage ..	5 to 40 per cent. according to the composition of the cast iron	Up to 100 per cent.	Up to 100 per cent.
Temperature of the molten iron	1,500 deg. C.	1,550 deg. C.	As required
Thermal efficiency ..	25 to 35 per cent.	40 to 50 per cent.	About 60 per cent.
Iron loss	2 per cent.	1 per cent.	—
Carbon loss ..	—	—	—
Silicon loss	12.5 per cent.	0.3 per cent.	—
Manganese loss ..	20 per cent.	8 to 15 per cent.	—
Sulphur pick-up ..	0.04 per cent. S	0.025 per cent. S	—
Coke rate	15 per cent.	10 per cent.	—
Electric power consumption	—	—	Melting: 550 kwh per *tonne* Superheating: 40–50 kwh per *tonne* per 100 deg. C. Holding: 15 to 20 kwh per *tonne* per hour

cupola but less than that for the induction furnace. The temperature of the melted iron is adequate, the sulphur pick-up amounts to about 0.025 per cent. S.

In the induction-melting furnace the power consumption amounts to approximately 550 kwh. per *tonne* of iron and there is practically no melting loss (*i.e.*, there is practically no oxidation of the metal), the capital charges are relatively high, the temperature of the melted iron can be as high as desired and there is no sulphur pick-up.

In the matter of the cost of the raw materials, the cold-blast cupola can only consume a small proportion of steel scrap and a limited quantity of returns, whereas the hot-blast cupola can consume as much of both as may be desired. On the other hand, the induction furnace, since it entails no sulphur pick-up, can be used to melt all the ordinary charge constituents.

If only the cost of the fuel be considered then economic parity is found between the cold-blast cupola and the induction furnace when 1 *tonne* of coke costs the same as 3,670 kwh. of power and the same parity exists between the hot-blast cupola and the induction furnace when 1 *tonne* of coke costs the same as 5,500 kwh.

These relationships have been set out graphically in Fig. 7 where it can be seen how low the price of electricity must be to obtain this parity according to the different prices paid for coke. If coke costs 120 Swiss francs per *tonne*, as is the case in Switzerland now, then the parity price for electric power in the induction furnace is 3.2 Rp per kwh. for the cold-blast cupola and 2.2 Rp per kwh. for the hot-blast cupola.

A comparison on this cost basis alone, however, can lead to a false conclusion, for melting in the induction furnace can still be competitive with the cupola-melting process at electricity prices higher than those given here. A comparison on the basis of fuel cost alone does not allow for the fact that melting in the induction furnace has certain other economic advantages over cupola melting, *e.g.*, practically no melting loss, no sulphur pick-up and a wide choice of available temperature, all of which means a greatly improved iron quality.

All these factors lead to the conclusion that in those countries (*e.g.*, Switzerland) where coke is dear and electric power is comparatively cheap, the melting of cast-iron in the induction furnace is more economical than melting in the cold-blast or the hot-blast cupola if one takes into account the fact that the quality of the resulting cast-iron is improved.

Conclusions

When faced to-day with the problem of installing a new melting plant in the iron foundry, the question has to be settled whether on the grounds of economy and of iron quality, a cupola furnace or an electric melting furnace is likely to be more suitable. In general to-day the installation of a hot-blast cupola will be considered preferable to a cold-blast cupola, and for reasons of iron quality an induction furnace will be preferred to an arc-furnace, so the question as a rule resolves into a choice between the hot-blast cupola and an induction furnace.

Since a melting unit is generally intended to last at least for a few decades, one should not confine the examination entirely to present-day conditions, particularly in view of the fact that, as shown above, the future may well see a more favourable relative price for electricity.

In spite of this, however, the hot-blast cupola merits serious consideration, particularly if the price of coke is cheap in comparison with the price of electric power and in cases where the composition of the cast-iron made is not intended to be varied throughout the course of a day's melting, provided that the degree of sulphur pick-up is not dangerous.

In cases where there are only limited means to hand to finance the installation, or where the electricity supply is limited, the hot-blast cupola is to be strongly recommended especially for large daily outputs of iron.

On the other hand the induction furnace must be considered first when the quality of the iron is the principal factor, and where iron at a high temperature and with the lowest possible sulphur-content is required. In cases where ferro-silicon and ferro-manganese are expensive (they are scarcely lost at all in the induction furnace) and where the melting programme is varied, and above all where the price of electricity is low compared with the price of coke, the induction furnace is by far the best choice. Since the first cost of an induction-melting plant is generally high its installation entails considerable capital, but in countries where the price of coal is high the question of installing induction-melting plants is being constantly discussed.

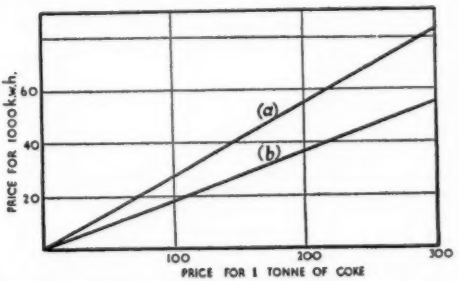

FIG. 7.—*Economic parity in the cost of electric power and coke for melting cast-iron: (a) cold-blast and (b) hot-blast cupola.*

If electric power becomes steadily cheaper in the future, compared with the cost of coal, it is certain that the electric furnace, in the form of an induction-melting plant, will be ever more widely installed throughout the iron-foundry industry. In view of the kind of developments which are to be expected in the future the induction furnace may well become an ideal method for melting cast-iron.

Summary

The continual increase in the price of coal compared with the price of electricity and the increasing

Comparative Study of Melting Furnaces

demands for improved quality cast-irons are both leading to a re-appraisal of the use of melting furnaces in the iron foundry, particularly as in the future the cost of an electric-calorie may well become less than the cost of a coal-calorie. Against this background the use of the cold-blast cupola, the hot-blast cupola, the arc furnace and the induction furnace as melting units in the foundry are considered and compared.

Owing to the different modes of operation of these furnaces and the resulting differences in the quality of the iron they produce, a direct comparison between them is not feasible. The examination is therefore mainly concerned with a discussion of the advantages and disadvantages of each and an indication of when the use of one or the other type of melting unit is to be preferred.

The points chiefly discussed are, how the use of these furnaces affects the quality of the iron, how they compare as production furnaces and which factors influence their economy.

Already to-day under special conditions, mainly in cases where the quality of the iron is of prime importance, the induction-melting furnace is economically competitive, particularly in those countries where the cost-relationship between the electric-calorie, and the coal-calorie is now, or very soon will be, in favour of electric furnaces.

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Aachen's New Foundry Head

The Minister for North-Rhine-Westphalia has appointed Dr. Ing. W. Patterson to the Chair of Foundry Technology at the University of Technology for Rhineland-Westphalia at Aachen, Germany. The appointment takes effect from October 1 and Dr. Patterson will also be the director of this Institute. Dr. Patterson, who descends, on his father's side, from an old English mining family, was born at Gelsenkirchen in 1911. He spent his childhood at Dortmund, where he went to school and where his father had a position as works manager of the Hoesch Iron and Steel Works. After completing his studies at the University of Technology, Aachen, he chose the academic career and became assistant at the Institute of Metallurgy and Foundry Technology. In order to acquire practical experience, he went into industry at the end of 1940. From this date until the end of the war he was departmental manager at the Light Metal Works, Rackwitz, Leipzig. During 1949, he was employed at a metal works and subsequently rejoined the Institute of Foundry Technology at the University of Aachen in order to continue his university career. He was admitted in March, 1953, as lecturer. In January, 1954, he took over the management and organization of the Institute of Founding at Düsseldorf, which was completed in the autumn of the same year.

NUM's Vice-president's Four-point Plan

Mr. C. S. Garland, vice-president of the National Union of Manufacturers, was guest speaker at the annual dinner of the Dudley area branch on October 14. Mr. Garland said the country was in serious danger of being priced out of world markets and the chief criticism the NUM had against the Government was its failure to review Governmental expenditure of money and manpower. Other remedies suggested, such as dividend limitation, import licences, an autumn budget and purchase tax, were but a negation of what had already been done. The only true answer was an independent inquiry into Governmental expenditure.

Referring to automation, Mr. Garland said that the total number of employed in this country was 23,800,000. When this figure was split into the various trades and the figures analysed, the result showed that not more than 2,000,000 of these would be affected by automation. "Automation is a thing which is steadily and surely coming," he added, "but it will not affect the employment of anyone, except that it will bring in its wake a higher standard of living."

Mr. Gilbert Salter, branch chairman, presided, and also present was Mr. John Parker, vice-chairman. Mr. Parker was elected at the business meeting which preceded the dinner, to succeed Mr. Salter as chairman. Mr. W. Hanke was elected vice-chairman, and Mr. B. T. A. Woodall hon. secretary.

Midlands Industry Report

Mr. Butler's credit squeeze is so far having no effect on either production or industry, Major C. R. Dibben, chairman of the Midland Regional Board for Industry, reported on October 18. A Ministry of Labour report to the Board stated that during September 600 redundancies were notified to the Ministry exchanges in the region. Mr. W. E. Davis, the Ministry's Regional Controller, said he did not think these redundancies were a serious number, indeed they were "extraordinarily low" when it was remembered that the region had 2,000,000 people at work. Not all the workpeople affected by redundancy had to leave the firms concerned, as some were found alternative work. It was stated that vacant jobs in the area on September 21 totalled 52,802 compared with 57,883 on July 27.

Replying to questions about steel shortage, Mr. H. D. Andrews (Deputy Regional Controller) said that although production was increasing, so was demand. The overall deficiency might not be large, but the problem was that of getting the right sort of steel to the right people at the right time. The chairman said that alloy steels were particularly short. The Board appointed a special committee comprising employers and trade union representatives to investigate why some firms in the area were lagging behind in providing greater fuel efficiency. The committee would give particular attention to possible causes of wasteful use of fuel, such as failure on the part of managements to appreciate the potential scope for economy; lack of training in the boiler house; and difficulty in obtaining and financing more efficient plant.

Mr. A. N. Dodson, Regional Controller of the Ministry of Fuel and Power, presented figures of coal stocks now in hand in various industries, showing that the fine summer has enabled firms to build up higher stocks than they had at the equivalent period last year. He showed that iron and steel had 3.1 weeks' supply and that engineering had 6.9.

Correspondence

(*Continued from page 462*)

DEFECTS IN CUPOLA-MELTED IRON

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—During the past seven or eight years we have been approached on several occasions by metallurgical colleagues engaged in the production of cupola-melted iron, and have been told that the metal being produced by these unfortunate gentlemen has been full of holes, or that occasional blowholes are appearing where this defect had not been known before. The usual sources of gas defects in these circumstances have always been checked, core venting is adequate, and no damp pouring-bushes or ingates are present.

In the early part of this period, the foundry with which we were associated had had occasional spells of mysterious "gas-hole" production, all the more aggrevating since no clues could be obtained as to the probable origin of the defects. For a considerable time, it was believed that the method of cupola-blast control was at fault, and great pains were taken to avoid any possibility of incorrect air supply to the cupolas. However, this defect could not be brought under control by this or other known means, and on occasions, fortunately rare, a considerable amount of scrap was produced due to the appearance of these mysterious gas defects.

For about three years, this problem was with us, and during this time we examined many of these holes under the microscope. It was noticed that in a few a very minute greenish glassy bead was still intact. This could only be observed in castings taken from the knock-out; once shot-blasting had taken place, these beads could not be found. For 12 months, about 50 such castings yielded sufficient material to give a clue as to its identity. The particles had an average composition of MnO 36.2 per cent. and SiO_2, 41.0 per cent., with CaO per cent. nil. This was an unexpected result, since general opinion favoured the theory that the material was cupola slag, and also that the presence of this material had nothing to do with the gas hole itself.

This gassy metal was not abnormal in composition, as revealed by analysis, but in spite of this it was thought that periodic abnormal sulphur content might occur and cause the formation of the slaggy material. The next time trouble occurred, the ladle slag appearing during casting was collected, and was found to have the general composition MnO 42.0 per cent., SiO_2 45.4 per cent., and CaO per cent. nil. Moreover, it was also established that the rate of formation of ladle slag was higher than normal during these periods of gassy-metal formation. To check this point, experiments were carried out as nearly as possible at the same temperature, in which both S as FeS and Mn as ferro-manganese were added to consecutively tapped ladles of metal. Into these ladles, weighed pieces of prepared refractory brick were dipped so as to be half submerged in the carefully skimmed metal. After a carefully checked period of time the brick was removed with its adhering ladle slag and reweighed.

This sampling was repeated under various conditions, and from the results obtained it was found possible to derive curves indicating that similar rates of slag production were obtained by either an increase in sulphur or an increase in manganese. The manganese addition, however, produced two types of slag, one appearing later than the other. These slags generally had the composition MnO 40 to 46 per cent., but the first slag had S 0.05 to 0.07 per cent., and the second 0.3 per cent. S. The artificially produced metal giving these slags, and more particularly that yielding the 0.3 per cent. S slag, which was, of course, cooler, gave castings having gas holes identical to those produced in the scrap castings first mentioned.

During this experimental work, it was observed also that hematite iron containing high Mn was occasionally being used. This had 1.4 per cent. Mn, and was only added to the extent of a maximum of 10 per cent. of the charge. The addition of this material, however, although not appreciably raising the final manganese content, was shown to produce metal prone to gas-bubble formation. The ladle slag produced from a normal cupola charge having Mn 0.6 to 0.8 per cent., and S 0.11 to 0.13 per cent., contained 10 to 14 per cent. MnO. However, when a charge having 1.25 per cent. Mn was used, the slag contained 41.5 per cent. MnO, and the metal was found to give slag and gas-hole troubles. From observations of many months' records, it was found that whenever the Mn content of any material charged was over 0.9 per cent., and particularly whenever the final manganese percentage rose to above this figure, there was a sharp rise in the incidence of gas troubles.

Attention was also directed to the cupola-slagging practice during this investigation. Analyses of slags were made at frequent intervals in an endeavour to correlate the occurrence of the gas defect with any abnormal slag formation. Here, it was found that an increase in sulphur in the metal was invariably accompanied by an increase in the MnO in the slag, and that increasing the manganese charged did not have any marked effect in reducing the final sulphur content of the metal, unless an increase was simultaneously made to the limestone addition. If this increase in limestone was not made, then gassy metal was produced.

It is not difficult to see and explain theoretically why an increase in Mn in the melt causes an increase in ladle-slag formation. The simplest explanation is that with increasing Mn content MnS will start to separate from the melt at a higher temperature and hence at an earlier stage in the cooling. Also, the recently published work of Turkdogan *et. al.* on the desulphurization of carbon-saturated iron (J.I. & S. Inst. April, 1955) satisfactorily explains personal observations concerning the changes in slag composition and the necessity for increasing the CaO content, but observations on manganese additions show that gas-bubble formation appears to be independent of the sulphur content of the metal. In the writer's view, the widespread practice of adding a "bit more" ferro-manganese if it is known that high-S-bearing raw materials are being used, may easily result in gas-hole production, which is usually blamed on the sulphur variation, and we suggest that it would be wiser to leave the manganese alone and attend to the CaO content of the cupola slag.

Since carrying out this work and making these observations, it has been noted that Jolly (BCIRA *Journal of Research*, February, 1954) has shown that under certain conditions, as the Mn content of the melt approaches the Si content (*i.e.*, as the Mn content is increased) the tendency to form slag and MnS-type inclusions becomes greater. This is in keeping with personal observations made.

This present work is allied to the mechanism of formation of MnS-type inclusions, and we would welcome any comments of readers concerning the observations recorded in this letter.—Yours, etc.

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October 14, 1955.

C & G Examination Results

The following statistics have been issued covering the results of the City and Guilds of London Institute examinations in Foundry Practice and Patternmaking for the year 1955:

Foundry Practice—Intermediate

	1955.		1954.		1953.	
		Per cent.		Per cent.		Per cent.
Candidates ..	352	100.0	276	100.0	259	100.0
First-class passes	64	18.3	53	19.2	49	18.9
Second-class passes	211	59.9	176	63.7	171	66.0
Failed	77	21.8	47	17.1	39	15.1

Foundry Practice—Final

	1955.		1954.		1953.	
		Per cent.		Per cent.		Per cent.
Candidates ..	174	100.0	170	100.0	138	100.0
First-class passes	39	22.4	30	17.6	25	18.1
Second-class passes	91	52.3	103	60.6	87	63.1
Failed	44	25.3	37	21.8	26	18.8

Patternmaking—Intermediate

	1955.		1954.		1953.	
		Per cent.		Per cent.		Per cent.
Candidates ..	463	100.0	442	100.0	361	100.0
First-class passes	69	14.8	57	12.9	31	8.6
Second-class passes	253	54.6	246	55.6	179	49.6
Failed	141	30.6	139	31.5	151	41.8

Patternmaking—Final

	1955.		1954 .		1953.	
		Per cent.		Per cent.		Per cent.
Candidates ..	265	100.0	210	100.0	165	100.0
First-class Passes	49	18.5	33	15.8	26	15.7
Second-class passes	140	52.8	99	47.1	87	52.7
Failed	76	28.7	78	37.1	52	31.6

The IBF committee noted with satisfaction the continued increase in the candidates for all examinations.

Control of Scrap Metal

The scrap metal trade will continue to play an important part in national production, says the report of the Working Party on the Sale of Old Metals and the Control of Dealers in Old Metals, which was appointed in February last year. But the acute shortage of lead and other non-ferrous metals and the increase in their value make them particularly attractive to thieves and receivers and there has been a notable increase in thefts of metals.

The report states that the reputable trader is as anxious as anyone that dishonesty in the trade should be adequately dealt with and he recognizes that some form of control is necessary. The problem is to find ways and means to improve the present law to combine the maximum protection against crime with the minimum of interference with legitimate trade. The report suggests that most of the law relating to the dealers should be repealed and re-enacted so far as necessary in one statute, based on a universal system of registration of dealers with local authorities. Dealers should be required to keep a record of sales and disposals as well as purchases and acquisitions, says the report.

Reducing Noise from Industry

Representations for legislation to enable local authorities more effectively to reduce excessive or unreasonable noise or vibration are to be made to the appropriate Ministry by the Association of Municipal Corporations. The Association's decision was taken at a meeting at which members of its council amended a recommendation of its Health Committee that general powers to deal with the nuisance would be difficult to administer and that no useful purpose would be served by further action.

Inconvenience caused by noise from industry was referred to by Mr. J. H. W. Glen, who moved the amendment. Approaches to offending industrialists were sometimes made successfully by local authorities, but only sometimes, and Mr. Glen felt that proceedings by individuals were not always appropriate.

The attitude of the Association's Law Committee was explained by Mr. P. B. Dingle, Manchester's town clerk, who said that local authorities who had sought powers from Parliament had difficulty in obtaining effective provisions, and there was always available to industrialists the defence that they had used the best practical means of mitigating the nuisance having regard to the cost. Furthermore, past experience was that any organization powerful enough could secure exemption.

Although it was desirable to obtain more effective powers, the Law Committee considered that it was undesirable to seek legislation that might undermine existing remedies. Noise could be a nuisance in common law whatever the circumstances, and the advice of the Committee was that the Association should seek to arouse public support for future action rather than make requests now for powers that could not be enforced.

Reporting on experiences of local authorities who had adopted by-laws about noise. Sir George Banwell, secretary of the Association, said that general legislation might be difficult to administer. What was considered excessive, unnecessary, or unreasonable in one area would probably be commonplace in another. There was little doubt, he said, that absence of a specific local remedy had left residents with a sense of grievance, and there appeared to be a general wish for legislation to enable authorities to take effective action.

Solar Energy Symposium

A number of scientists who are to represent Britain at the first world symposium on applied solar energy, to be held in Arizona next month, left on October 15 for the US. They will travel first to Tucson, Arizona, for a two-day conference, sponsored by the Association for Applied Solar Energy, and then on to Phœnix, where the symposium is to be held from November 1 to 5.

The British party includes Sir Edward Bullard, director of the National Physical Laboratory, and Dr. Harold Heywood, Reader in Mechanical Engineering at Imperial College, London University, who is to address the conference on the operation of thermo-electric generators by solar radiation. Dr. Heywood, who is a member of the symposium advisory committee, will also preside at a discussion on solar house heating. Nearly 1,000 scientists are expected to attend the symposium.

SIX FIRE ENGINES of ten years old and upwards have been disposed of by the Glasgow Corporation to a dealer for £726.

Behaviour of Moulding Sands at High Temperatures*

Discussion of the Congress Paper by W. B. Parkes and R. G. Godding.

The discussion makes clear that founders are ready to accept high-temperature testing of the type disclosed by the Authors for supplementing information on the behaviour of moulding sands, but doubt its practical application to replace ordinary sand-control methods. The individual and combined effect—and absence—of coal-dust and wood-flour are dealt with at length. Several other materials are proposed as additives, including sodium-carbonate and seawater, and the relative influence of sand grain-distribution is queried.

The Paper "Behaviour of Moulding Sands at High Temperatures," by W. B. PARKES and R. G. GODDING, who are respectively the assistant development manager and sands investigator of the British Cast Iron Research Association, was presented at the International Foundry Congress by Mr. Parkes, with Mr. J. Bell and Mr. J. Drachmann (Sweden) as joint chairmen.

Value of Coal-dust

Opening the discussion, Mr. R. D. LAWRIE said the Authors had made a very significant remark when they stated that coal-dust was not as efficient as wood-flour when it came to reducing scabbing. Some years ago, he had endeavoured to try and clean up the foundry—the dirt and the smoke and the grime which was associated with green-sand moulding, using coal-dust. At that time, the foundry was making commonplace castings and he had started off with sand plus bentonite and no coal-dust, and he found he got delightful conditions as far as the shop was concerned, with no dust, fumes or smoke, but he had found scabs on the casting. The foreman had pleaded with him to let him use coal-dust in order to reduce the incidence or scabbing, but he had refused to allow any coal-dust to be used. However, about a fortnight afterwards he suddenly saw a very significant improvement in the surface finish of the castings and he said to the foreman "Ah, now we are getting somewhere!" The foreman had replied: "Yes, Sir, I am using 2½ per cent. coal-dust."

MR. PARKES, in reply, said Fig. 13 showed that the addition of coal-dust to sand increases the amount the sand can be deformed without cracking at temperatures above 400 deg. C. and in consequence tends to reduce scabbing. In some cases, however, the defect cannot be entirely eliminated by the addition of coal-dust alone, and the addition of wood-flour, which permits a much greater increase in deformation and is therefore more effective, is required.

MR. K. REINDES (Netherlands) asked the Authors if there was any connection between the metal penetration into moulding sand and the results as measured in the high-temperature apparatus. He had in mind the occurrence when, after knocking-out a casting, one found a piece of sand which was quite full of iron.

MR. PARKES said that the equipment could not be used to give information in cases of simple metal penetration between sand grains. A number of papers on this subject had been written and could be consulted. Where, however, pentration started at a crack in the mould surface and extended into softer-rammed areas behind the mould face, the equipment would be helpful, since such cracks frequently occurred in sands having high expansion and low deformation characteristics.

MR. REINDES said in his foundry a certain casting was produced for which straight oil-bonded sands were used, and if there were signs of severe metal penetration, about 2 or 3 per cent. wood-flour was added. In this way, penetration was eliminated for maybe 80 per cent. of the castings.

MR. PARKES said that he was glad to have the information, but he was not sure whether the equipment could be used to give a lead on this problem. Now that the question had been raised he would look into the matter further.

An Outstanding Contribution

MR. A. TIPPER said the Paper was an outstanding contribution to the study of sands throughout the world and he believed it would set a great many people working along similar lines. The ordinary foundryman was going to have difficulty first of all in finding some control method or yardstick for measuring the changes in his sand, and he would like to ask the Authors if they could give a little advice to foundrymen on methods of measuring the deformation constant or the brittleness index in their day-to-day sand systems. Supposing the fact were accepted that a foundryman could not change his expansion characteristics and he therefore proceeded to work on altering the deformation, how should he do that? Could he employ his standard sand-testing equipment, using first of all the standard tests for compression, and measure deformation on the compression test-piece with standard-ramming technique, and then could he apply that by observing the effect on his scrap in the foundry of various additions?

Secondly, if it had not already been done, he would like to suggest that the influence of sodium-carbonate additions to sands should be investigated by the high-temperature method. He had heard that additions of that sort could reduce the incidence of scabbing and he knew at least one foundry in this country where this was being done and it was claimed to be definitely reducing their incidence of scabs on green-sand work. He, personally, believed

* Paper printed in the JOURNAL August 11, 1955.

that some investigation into the effect on the deformation and perhaps on the brittleness-index of a standard sand of sodium-carbonate additions would be well worth carrying out.

MR. PARKES replied that it would not take very long to examine the effects of sodium-carbonate additions. Most of the tests reported had, however, been carried out with sodium bentonite as a binder and he did not think that the addition of sodium carbonate would do much more than reduce green-strength. The limiting factor with regard to carrying out more tests was that only one piece of apparatus had been constructed. On a recent occasion, he had begun to draw up a programme of work and in an hour or so had produced one which would require ten years for completion. Progress would only be slow, unless similar pieces of equipment were built by others.

With regard to application in the foundry, he did not know the answer, but would like to make two points. The first was that when the sand in use did not contain coal-dust or any other material which softened readily on heating, a room-temperature test was adequate, and for £20 or so it should be possible to build apparatus which would give useful information. The second was that although the high-temperature equipment would be required for sands containing coal-dust, there was no alternative in sight which would give information as to the properties of the mould surface during the period when molten metal was poured into it, and whatever the equipment cost he would have wished to have something of that type when he was employed in a foundry. It was, however, unlikely that a small foundry would be prepared to build the equipment, since the type described had cost £500 in cash and five years of hard work. The BCIRA would, of course, be only too pleased to give any information which would help in the construction of similar equipment elsewhere.

The Human Element

MR. H. HAYNES said scabs were not caused by sand but by the human element in spite of the sand. He had one question to ask: If he left out coal-dust and wood-flour and introduced powdered lime what would the results be?

MR. PARKES said that he did not know, as he had never tested sand containing this material.

MR. HAYNES said that he was referring to an 18-ton casting made in green-sand and he had written a Paper on that particular subject which had aroused considerable discussion. The casting was 30 ft. long with 6 in. of metal thickness over the green-sand, and four men had made two castings in a week, showing no scabs.

MR. PARKES said that all he could do was congratulate the speaker, as he would anyone who could make 18-ton castings in green-sand moulds. Unfortunately some foundries had scabs on castings which were 18-in.—not 18-ft.—long.

MR. HAYNES said he thought the trouble was attributable to the human element.

MR. H. G. HALL, F.I.M., asked the Authors whether, as a result of all the work which had been done on their particular apparatus, they now considered the conventional hot-strength test to be completely useless.

MR. PARKES, from his experience, replied that that was the case.

MR. N. E. TIDSWELL, reading the expansion figures given for silica and quartz, said he could not quite make out why they had been given because they appeared to be strictly expansion figures for silica sand. He thought the expansion of quartz was normally much lower than the figures given in the text of the Paper and was interested to learn whether the Authors had made any direct differentiation between silica and quartz.

In reply, MR. PARKES said the figures shown in Fig. 8 were taken from Sosman's standard work on the subject.

Scab-free Castings

MR. G. J. ROGERS said, in his view, the Paper was most valuable because it was helping foundrymen to face up to the question of how to make castings in green-sand moulds without scabs. At the moment, he was carrying out some work in producing iron castings, using both wood-flour and coal-dust, and it appeared that the results were better by using both instead of coal-dust alone. This was the first time he had come across any factual information, but he personally felt it was not possible to produce—at any rate in the Southampton grade of sand he was using—good, clean castings when using only wood-flour as an additive. It was possible to produce them without scabs, but there one came back to the question raised by Mr. Reindes—and he thought that question had not been answered because it had not been properly understood—namely, that although scabbing could be eliminated one still got considerable burning-on. The introduction of coal-dust prevented that, and one got a good clean casting from the mould, instead of a casting free from scabs but which had much sand adhering to it in a semi-fused condition. Would Mr. Parkes agree that, in order to produce a sound, clean casting, free of metal penetration, it was necessary to use both wood-flour and coal-dust?

MR. PARKES agreed that it might be necessary to use some coal-dust. It was a matter which was causing considerable concern, since it was the presence of materials such as coal-dust which made it impossible to use room-temperature tests for obtaining the properties of sand which was being heated rapidly.

With reference to metal penetration into Southampton sand it should be remembered that this sand contained granular material other than quartz, which had a comparatively low fusion-point. With very hot pouring, it would be possible for metal penetration to occur following fusion of these grains, such as occurred to some extent when pouring very-hot mild-steel into a red-sand mould.

MR. ROGERS asked what proportion of coal-dust the Authors would recommend for the ordinary red sands.

MR. PARKES replied that the proportions depended on the thickness of the casting; for a fairly light-section casting, 3 to 5 per cent. of fine coal-dust should be sufficient, but when using fine-grain sand the amount which could be added was limited by its effect on permeability.

"Coal-dust Prohibited"

MR. J. HIRD said the Authors might be interested to know that in 1944/45 he was in charge of a foundry producing about 80 tons of castings weekly for the electric-motor trade and he ran that foundry for 18 months without using any coal-dust whatever. The improvement in conditions was remarkable. Instead, he had used wood-flour, and provided the moulds were rammed hard the finish was good. Although with a soft-rammed mould the finish was poor, it would be poor in any case if one rammed the mould badly. He had also found much less new red sand was needed, his theory, rightly or wrongly, being that in using wood-dust there was introduced much less tarry matter which would in the normal course act contrary to the clay and partially "kill" it. With wood-dust, one did not get the same deterioration in green-strength.

MR. PARKES said that the question brought to mind a paper by Mr. Hird's father, one which was particularly interesting because the author had succeeded in throwing light on the behaviour of coal-dust and its effect on the physical properties of sand without having any testing equipment whatsoever. Starting with a mixture of Southport sand and coal-dust, the earlier paper described how, by pouring metal into this sand, re-milling the sand with more coal-dust and repeating the cycle a number of times, a usable moulding sand had been produced which was bonded only with the decomposition products of coal-dust. Mr. Hird's experience was that these decomposition products impaired the bond of his red sand, but in this connection it should be noted that one of the decomposition products was pitch, and that although soft pitch could be used to bond a clay-free sand, all pitches appeared to reduce the bonding power of some clays.

The complete replacement of coal-dust by wood-flour might be possible when making thin castings, but with thicker castings small amounts of wood-flour did not give the smooth blue skin some foundries like to see. Larger amounts of wood-flour impaired the moulding properties of the sand and on a squeeze-type moulding machine, for example, sand with 3 to 4 per cent. wood-flour behaved like rubber and expanded when the pressure was released. Since it was difficult to estimate the amount of wood-flour in sand, the amount added must be kept to a minimum to avoid any risk of a gradual build-up.

MR. HIRD said he was making castings for his own firm's machine-shop and not selling them elsewhere. He got a good smooth skin, but not a very blue one.

MR. PARKES said, in his experience, supplying to a "tied" foundry was worse than selling outside. If a firm found a cracked casting which had been "bought-out" they had to pay for it, unless they detected it before machining, but if it had been made in the firm's own foundry, it did not seem to matter if it had been on the road for six months, the founder still got the blame for it!

MR. H. F. SLAGHUIS (Netherlands) asked if it was correct that to get a nice smooth surface on castings one should use sand grain-distribution over three or four sieves.

MR. PARKES said that there was no particular virtue in grain-distribution of that order. With a sand of very uniform grain-size, the tendency for scabs to form was rather greater than with a non-uniform sand. There were probably two reasons for this; first, all grains in the surface layer would heat up at the same rate so that they reach the $\alpha-\beta$ quartz change-point at the same time, and the maximum effect of the immediate expansion at that point would be felt; secondly, deformation tended to increase as the spread of grain-size increased. The use of a sand grain-distribution over three or four sieves would not of itself, however, be sufficient to prevent scabbing.

MR. SLAGHUIS said what he meant was that by using a sand of that grain-distribution one could diminish the percentage of coal-dust and wood-flour incorporated and still get a good solution to the problem.

MR. PARKES said the effect of grain distribution was too small to be readily detected in sands containing appreciable quantities of wood-flour.

Applying the New Apparatus

MR. A. J. SHORE said recently his firm had changed from one foundry to another, still making the same sort of product. Both produced moulds from local, naturally-bonded green-sand but formerly they were rammed by hand—with the human element in control—and now were rammed by a new type of impeller rammer where the control of ramming was very much more difficult. The incidence of scabbing had increased, but the moulds were very much better, there was better definition and fewer of other foundry troubles, and he had wondered whether the scabs were in fact expansion scabs. Mr. Parkes had mentioned expansion scabs, but apparently there was another sort of scab and he was never very clear as to the cause of those two types.

Mr. Parkes had said that his apparatus was quite expensive. . . .

Here, MR. W. B. PARKES interjected ". . . in time."

Whereupon MR. SHORE resumed by saying he had wondered whether it would not be a good idea to have the equipment as a piece of control apparatus. In his organization a man spent all his time taking tests and there was a certain amount of scabbing. If they did not get other troubles, could the firm, by installing the new apparatus, do away

Moulding Sands at High Temperatures—Discussion

with other tests, thus, in actual fact, saving quite a lot of testing time?

MR. PARKES said that, dealing with the last point first, not much benefit could be obtained by eliminating scabbing, if difficulties due to other causes increased—if, for example, drop-outs occurred because the sand was too weak. The use of the high-temperature testing equipment would not therefore permit dispensing with other control tests. He would be only too pleased to give Mr. Shore all possible help in getting the equipment to work, but it would be necessary to engage a man with considerable knowledge of electronics to operate it. Mr. Shore's experience with his new machine was what would be expected. With harder ramming, there was better definition and the castings would be more accurate dimensionally, but expansion would increase without any increase in deformation, and there would be more scabbing. He was in a position somewhat similar to that of Mr. Haynes, in that he was making, in green-sand, castings which many foundries would hesitate to make by that method.

MR. HAYNES asked Mr. Parkes if he would agree that if one had a foundry near the seaside and used sea water for moistening the sand, one could dispense with coal-dust and wood-flour and thus stop scabbing.

MR. PARKES, in reply, said that he could not say what the effect of sea water would be, but was of the opinion that sea-weed was likely to be more useful.

THE CHAIRMAN (MR. J. BELL) said Mr. Parkes had stood up well to the barrage of questions, and he asked the meeting to show their appreciation not only of Mr. Parkes' presence at the meeting but of the work he had done.

The vote of thanks was carried with acclamation.

Mould Reinforcement Causes Waster

By "Coroner"

Whereas in production shops the groove in a sheave wheel would invariably be formed by a dried core, in jobbing shops resort is often made to a "floating joint," thus making the groove in green-sand as a part of the mould. To support the "cod" of sand forming the groove, reinforcement by iron bars is necessary and care has to be exercised in their use if trouble-free castings are to be produced. To ensure the sand adhering to these bars it is customary to dip them in a clay-wash mixture, prior to insertion in the mould.

Occasionally these castings turn out defective. Such a case occurred recently, but it was quite a while before the cause of the trouble was diagnosed. Hard ramming of the "cod" was first suspected but this could not have been the cause of the trouble for the sand was tucked-in by hand and not rammed in the usual sense of the term. The clay wash was then suspected, for if this is not well mixed it is possible for lumps of damp clay to adhere to the bar and thus cause excessive moisture locally, with the result that "blowing" occurs. This, it was found, was actually the cause of the particular casting being scrapped, due to a gassy patch on the top of the rim portion. It was an example of the trouble that can occur when the clay-wash mixture is not correctly mixed.

More Power for "International" Tractors

Power has been boosted in two of the Diesel crawler tractors marketed by the International Harvester Company of Great Britain, Limited. The new heavy-duty, four-cycle, four-cylinder engine of the TD-14A develops 86 h.p. at 1,500 r.p.m. The TD-14A has 72 drawbar h.p. and a drawbar pull of 17,100 lb. at rated governed speed. The engine also has improved cylinder heads and features a new type of fuel-injection pump.

The TD-18A now has 103 drawbar h.p. and 24,300 lb. drawbar pull with six forward and two reverse transmission speeds, ranging from 1.6 up to 5.5 miles per hour. Fuel-tank capacity has been increased to 75 gals.

"Drawing-through"

By "Tramp"

A method sometimes adopted in jobbing foundries to produce a casting of greater depth than the available pattern is by means of "drawing-through."

This can be accomplished in one of several ways. If the turn-over method of moulding be adopted, the pattern is placed on pieces of wood of the thickness by which the casting is desired greater than that of the pattern and the mould is rammed. The box is then turned over, the pieces removed and the pattern withdrawn. The pieces are then placed on the bottom of the mould and the pattern returned to position. The joint part is next finished and a top prepared as usual.

This method is to be preferred to that sometimes adopted of beating the pattern into the mould to obtain the extra thickness, for in this latter case, the sand in the bottom of the mould is thereby made much denser than as originally rammed and is thus quite liable to cause a waster through scabbing.

Should it be necessary to get a thicker casting, when the bedding-in method is employed, it is better to bed the pattern in as if it was to be produced of the thickness of the pattern, then withdraw it, and place pieces on the prepared face, returning the pattern and subsequently ramming to the increased depth. This is much better than forcing the pattern into the sand.

Oils for Heat-treatment

Oils for heat-treatment are reviewed in a useful brochure issued by Shell-Mex & B.P., Limited, Shell-Mex House, London, W.C.2. It is in 10 sections, two of them covering hardening of steel, quenching media and how they act; quenching oils, oil-quenching equipment, and evaluation of quenching power occupy four sections, two others dealing with the tempering of steel and tempering oils and equipment, respectively. The remaining two sections are devoted to laboratory tests on heat-treatment oils, and to Shell oils for the heat-treatment of steel. There are two appendices: (1) Heat-treatment terms and definitions; (2) viscosity conversion table.

Notes from the Branches

Newcastle-upon-Tyne

By invitation of the directors of the Associated Lead Manufacturers, Limited, members of the Newcastle-upon-Tyne branch of the Institute of British Foundrymen visited the Elswick works of that company on October 8, and were fortunate in seeing many sections of this large undertaking in operation. About 50 members attended and were separated into four groups.

A start was made in the sheet-rolling shop where two 15-ton capacity gas-fired crucible furnaces are located on opposite sides of a large casting table in which slabs are cast for rolling. The casting table, which was recently installed to replace one which had been in operation for about 25 years, is a single casting in hematite iron designed to supply slabs 10 by 9 ft. and about 5½ in. thick. The base of the table is about 4 in. thick and waste hot gases from the furnaces are used to keep it hot to prevent the possibility of the lead solidifying too quickly when cast to form the slab. Casting of these slabs is timed to suit the mill operations so that the slabs can be transferred to the mill while still hot. The rolling mill is in line with the casting table and the slab is conveniently lifted and located on live rollers and fed to the mill, which is reversible and electrically driven. It is a wide mill and is able to roll sheets 10 ft. wide of various thicknesses. The rolling speeds vary, being generally slower with the very thin sheets because of their greater tendency to stick to the roll. The finished sheets are trimmed, cut to required widths and lengths and coiled ready for transport.

Pipe Manufacture

An adjacent department houses vertical and horizontal presses for pipe-making. One vertical hydraulic press, operated with oil, is being used for pipes of small bore; the pipe being processed is led through a cooler, so as to control the crystal structure, and is subsequently coiled. A second vertical hydraulic press, operated with water, is used for larger, straight lengths of pipe to meet the requirements of the chemical industry.

An interesting feature shown to the visitors was the ease by which shaped plumbers' fittings were made by the control of opposing rams in a press and the speed at which the shapes could be produced. At the top of the die, through which the pipe was pressed, was a shallow cup into which a small amount of molten high-tin alloy was poured, this produced an excellent finish on the fitting. Apart from piping there were several other extruded lead products, notably a very large coil of material for leaded windows.

Roasting and Reduction

The roasting and reduction process of extraction as used at these works is based on the blast-furnace smelting of agglomerated ore or half-formed matte. Adjacent to the blast furnace were stored various ores, together with slags rich in the metallic impurities found in lead ores. The fumes from the blast furnace pass through a hood into a special container to recover metallic oxides, which are usually returned to the blast furnace. Molten lead is drawn from the bottom, while slag is tapped from the surface of the metal. The lead obtained from this process is always impure, carrying antimony, arsenic, bismuth, copper, iron, tin, zinc, and usually silver, and is subsequently refined in large furnaces containing iron vessels having a capacity of 50 tons of molten lead. One of the various methods employed to remove the impurities, is by heating the metal to the temperature of molten zinc, using some method of agitating the fluid mass and allowing it to cool. The zinc solidifies first and floats to the surface, carrying with it practically all the noble metals present, forming a crust, which is removed and treated separately for the recovery of the individual metals.

Applications

Uses of the metal lead are well known, but applications of the most important compounds of lead—litharge and minium—may not be so familiar to readers. These are used in glass manufacture, for pigments, glazing pottery, and for joining purposes in mechanical engineering. In addition to the extraction of lead and the manufacture of the various forms of lead products, which is the primary occupation at these works, a large department is allocated to the recovery of scrap aluminium for re-use. Advantage is taken of the facilities available for refining and casting in aluminium ingot form, ready for marketing, from the relatively impure material suitable for deoxidizing steel to the higher purities used in the aircraft industry, of AID standard. This shop is equipped with one large gas-fired open-hearth furnace so designed as to enable the melting of aluminium from mixed charges incorporating iron, copper, etc. The molten aluminium collects on the hearth from which it is tapped into ingot moulds for subsequent refining in gas-fired rotary furnaces, two of which are installed for this purpose. Although this development was only initiated in 1949, it is apparent that considerable business is done in this field.

Members of the branch found so much of interest in this visit—including such items as an old shot-tower in an excellent state of preservation—that the time allocated to it seemed all to short and this point was stressed when members expressed their appreciation individually for the courtesies extended to them by the firm and their guides.

Bristol and West of England

The opening meeting of the Bristol and West of England branch was held at the Grand Hotel, Bristol, on September 17. An audience of 45 members and friends heard an interesting and instructive Paper on the "Production of Cores by the CO_2 Process," by Mr. A. Talbot. Mr. T. Johnson who was also to have taken part in the meeting was, unfortunately, unable to attend. Outlining the rapid development and subsequent application of the Process, Mr. Talbot showed how readily it could be adopted by the average foundry in a very short while without interruption of the normal production programme. Benefits arising from its use were reduced costs, and the fact that storage life of prepared sand and completed cores were far in excess of those to be obtained by sands prepared by any other process. The need for proper maintenance of coreboxes was obvious, since the core could only be as good dimensionally as the box from which it was produced.

The interest the Paper produced was evident from the number of questions put at the close of the meeting. Replying, MR. TALBOT said the use of spirit blacking on CO_2 cores, although more costly, would invariably give better finish than blacked oil-sand cores. Blacking of cores was advisable where erosion might occur, but little penetration had in fact been found, even when pouring metal from considerable height. Breakdown difficulties reported as having been experienced by some workers, could usually be traced to bad mixing, unsuitable sands or unsuitable binder for a given sand; variation in pouring temperature

Notes from the Branches

appeared to have no effect on the breakdown properties of the cores. Since there was no necessity to bake cores, the possibility of their cracking was eliminated. Venting of cores must still be carried out in order to ensure removal of gas, but as less gas was evolved when using CO_2-treated sand the size or number of vents could be reduced.

In proposing a vote of thanks, MR. H. B. DAUNCEY said that the branch was indebted to Mr. Talbot for an instructive paper which had set out clearly the advantages to be gained from using the CO_2 Process. The industry, too, had much to thank Mr. Talbot for in so much that he had largely pioneered the work in this field. Mr. D. F. B. Tedds seconded the vote of thanks.

Sheffield & District

Sheffield & district branch held its opening meeting of the winter session on September 26, when Mr. R. F. Horton gave his presidential address entitled "Foundrymen." During the course of the meeting, the Institute's diploma was presented to Dr. B. H. C. Waters, for his paper entitled "Place of Shell Moulding in the Foundry." Following the official business, about 160 members sat down to dinner, after which the president extended the best wishes of the branch to Mr. J. F. Stanier (snr. vice-president, Sheffield branch) and his firm, on the occasion of the lighting up of their new blast furnace.

Coventry Section

Coventry and district section held their opening meeting of the 1955/6 session in the Coventry Technical College on October 11; Mr. V. C. Faulkner, F.R.S.A., HON. M.I.B.F., editor of the FOUNDRY TRADE JOURNAL, was present as guest of honour. Mr. D. E. Hancox, A.I.M., retiring president, introduced the new president, Mr. D. F. Bailey, who then delivered his presidential address, which was entitled "Prosperity and the British Foundryman." This very interesting account of the progress of the foundry industry and the manner in which it has assisted the development of industrial Britain over the last 200 years, was followed by a paper from the main lecturer of the evening, Mr. S. H. Russell. Mr. Russell presented his paper—"Foundries of To-day and Yesterday"—in a most interesting and entertaining manner. It was admirably illustrated and showed the marked contrast in methods employed 50 years ago with those of the modern production techniques. The paper was received warmly by the 80-odd members present and a most interesting discussion followed.

Extracts from Presidential Address

In the course of his presidential address to the Coventry section, referred to above, Mr. D. F. Bailey referred to the magnificent bronze statue of Lady Godiva, recently unveiled by Her Majesty the Queen, as a modern example of age-old art foundry practice. He queried whether the aircraft industry and indeed many members of the Institute realized that the present progress of the British aircraft industry owed much to the foresight of Mr. Edward Player who, as a foundryman, introduced magnesium founding from Germany into Coventry in 1920. The present output of magnesium castings from one of the foundries under his control, and within the area covered by the Coventry section of the Institute, exceeded the whole of Europe and was not surpassed by any one foundry in the USA.

Having reviewed the foundries' past and present contributions to prosperity he called attention to a very difficult, but non-technical modern problem with very old roots that founders had now to face. As a result of being the pioneer industrial nation British industries grew from small beginnings within cities and as industry flourished, the cities expanded, with factories, houses and shops all jumbled up together. In the light of present-day knowledge the authorities now considered as indiscriminate development, the depressive industrial sprawl that existed, for example, in the Black Country and some towns of Lancashire and Yorkshire. Modern town planners were faced with the difficult task of unravelling this inherited mess, and he fully agreed in principle with the policy of separating factories from dwelling and shopping facilities.

Opposition from Local Authorities

Unfortunately, however, some local authorities were showing themselves to be very unreasonable in their attitude towards foundries, and instead of being welcomed as an asset to the area for local employment and national prosperity, these factories were more frequently regarded as producers of obnoxious smells, smokes and airborne dust. Unfortunately, there was good ground for some complaints about airborne dust, much of which seemed to come from cupola stacks, and although some foundrymen might not agree he considered that generally iron foundries had been indifferent to this nuisance and could do very much to suppress it if they would only take the trouble to introduce water-spray type dust collectors or other suitable appliances to the cupola stack. Much of the objectionable smell from foundries was due to core baking and in this respect the two new CO_2 and shell processes of core making would help to reduce this.

With the drive for cleaner atmospheres in cities pressure was being brought to bear on many foundries for their removal to fresh sites, and he met with increasing frequency foundry managers who regarded as their biggest problem the foundry "squeeze" coupled with the anticipated loss of many of their present skilled workers when the foundry moved. On the credit side, it must be said that moving to a virgin site would allow for the erection of new style buildings more suitable for modern production methods and the opportunity to modernize, which may not have been possible on the old site. In some cases such modernization with its increased efficiency might not normally be undertaken or even considered without an initial push. For this reason, the foundry "squeeze" could be of national benefit as an increased number of modern foundries would enable British industry to combat the growing foreign competition and ensure the present prosperity continuing. He viewed the trend, however, with mixed feelings, for if the policy of squeezing out the foundries was pursued without common sense and discrimination it could upset the balance of industry and the prosperity which the foundryman had helped to create could disappear.

Mr. E. J. COSFORD, president and managing director of the Canadian Car & Foundry Company, Limited, Montreal, announces that Sir Frank Spencer, Sir Roy Dobson, Mr. Crawford Gordon, Jun., Mr. J. S. D. Tory, Mr. A. A. Bailie, and Mr. L. A. Bruce have been elected to the board Sir Roy Dobson has been appointed chairman and Mr. Gordon vice-chairman. The changes have been occasioned by the purchase of over 96 per cent. of the company's shares by A. V. Roe, Canada, Limited. Sir Roy is also chairman of the latter company and is on the board of its parent concern, the Hawker Siddeley Group, Limited.

Silica Dust, Foundries and the Factories Act (1937)

*By Laurence Webley, LL.B.**

The employer's legal obligation in matters concerning silica dust and the Factories Act, 1937, particularly under Section 47 (1) of the Act, has been to some extent clarified by the courts in recent months in the cases of "Gregson *v.* Hick Hargreaves & Company, Limited," and "Richards *v.* Highway Ironfounders (West Bromwich), Limited." Gregson and Richards were both moulders who had contracted silicosis in the course of their work and, accordingly, sued their employers for damages. Gregson, a man aged 58, had worked for the defendants from 1934 to 1951 and was certified as suffering from silicosis in January, 1951. The iron foundry at Bolton where he worked used moulds built up of bricks and loam. The defendants provided masks fitted with 30-ft. pipes the ends of which were tied to stanchions five or six ft. above ground to give the moulders clean air when they were removing the grids from the moulds. The "knocking-out" was done by labourers and, as a moulder, the plaintiff was 60 to 70 yards away from this process and no dust from it, apparently, reached him. During the "tipping," which was done, if possible, on Saturdays when few moulders were about, the doors were opened and the men sent out. The foundry floor was also damped frequently.

Practicable Measures

The judge referred to these measures and said that the danger of silicosis from ordinary moulding sand was a very recent discovery. The danger in a loam-moulding shop was, it seemed, first revealed by this case. The relevant portion of Sect. 47 (1) said that in every factory in which either dust likely to be injurious or offensive to the employees, or substantial quantities of dust of any kind was given off, all practicable measures must be taken to protect employees against inhalation of the dust or its accumulation. Employers were, therefore, obliged to protect both against injurious dust and also against substantial quantities of any kind of dust. But as regards injurious dust, the defendants neither knew, nor ought to have known, that such dust was caused by their moulding processes, nobody knew it, and Sect. 47 (1) should not be construed so as to fix employers with liability whether they knew the dust was harmful or not.

His Lordship continued that as regards protection against substantial quantities of dust of any kind it must be remembered that under Sect. 47 the means to be employed were all practicable measures. For almost 70 years, everyone thought the dust had been adequately got rid of and he did not think he should hold the defendants blameworthy when, by all the knowledge then available, they had given protection against inhalation of every kind. No criticism had been made of the absence of exhaust appliances in this moulding shop. They had not been installed in any moulding shop in the country, and some considered that installation would be impracticable. Accordingly, his Lordship held the defendants were not liable.

Second Case

Richards, a moulder in his forties, had worked for Highway Ironfounders since 1929/30. He contracted silicosis very seriously and the judge at the trial awarded him £9,645 damages. The employers appealed to the Court of Appeal which took the unusual course of ordering a re-trial. The Court of Appeal said it appeared that while "knocking-out," Richards was involved in thick clouds of dust. No one appreciated until about 1950 that this dust was dangerous but it was given off in substantial quantities and from July, 1938, the date when Sect. 47 (1) came into operation, the employers were bound to take all practicable measures against any dust in substantial quantities. In fact they took none. No one thought the dust would produce silicosis, but it was proved at the trial that possibly 20 types of respirators and masks were available to the industry for protection against dust inhalation although only one of them, the Mk. IV, had any effectiveness, whatsoever, against the dangerous minute particles in the grains of sand. The plaintiff said that among the practicable measures must be included the supply of Mk. IV masks which would have afforded some protection against his injury. The vital question was; had the plaintiff shown that, at the relevant dates between 1938 and 1946, when he had become seriously ill, the Mk. IV mask was the best all-purpose mask so that, in the natural course of events, all practicable measures would inevitably, or naturally, involve supplying them? If the answer was "no," had not the plaintiff failed to prove his case? Moreover, would the wearing of the Mk. IV mask from about 1940, when they became available, for the short period while the plaintiff was doing his own "knock-out" have been effective at all when he had already been exposed to lethal dust for about 10 years?

The Court of Appeal rejected a finding that it would be practicable to instal a dust-exhaust system in the foundry, saying that the dust did not originate from definable or fixed points, as the moulds were separate loose objects, and the employers were not in breach of Sect. 47 for failing to supply such exhaust appliances. The re-trial was ordered to deal with the question whether the defendants had failed in their obligations under Sect. 47 (1) by not supplying masks and, if so, to what extent this had caused the plaintiff's injury.

For the future, of course, now that the danger is known, all possible precautions must be taken against injurious dust as required by the first part of the Sectjon of the Act quoted.

* Barrister-at-law

ESC Steel Castings Centenary

This year English Steel Corporation, Limited, Sheffield, celebrates a centenary important in the history of the British steel industry. In 1855, after a visit to Germany, Col. Tom E. Vickers, son of one of the early pioneers of the present ESC organization, introduced to Great Britain for the first time a successful method of making steel castings which a Bochum steel founder, Jacob Meyer, had discovered the previous year. At the old Millsands works in Sheffield, belonging to Naylor, Vickers & Company, an early precursor of ESC, Col. Tom Vickers, who was appointed works director at the age of 23, began casting Britain's first steel cogwheels and railway crossings, using a moulding compound eventually known as "Sheffield compo," made of calcined fireclay obtained from old crucible-melting pots, mixed with a small quantity of new clay to make it plastic.

Steel Bell Production

His most notable venture, however, was the production of the steel bells, which in the succeeding years literally rang round the world. Cheaper and more sonorous than the usual bronze bell, over 7,000, weighing individually up to 7½ tons, had been produced by 1880. Many went to the United States, whilst others were sold as far afield as Russia, New Zealand, Syria and West Africa. More locally, within the British Isles, chimes and peals were supplied to the South Kensington Museum, the Glastonbury Astronomical Turret Clock, Knaresborough Town Hall and St. Giles' Cathedral, Edinburgh. Bell-founding was discontinued by the company before the end of last century, but not before heavier steel castings, such as ships' propellers, structural and other marine castings had taken their place.

Present-day Foundry

Since then, the company has developed its foundry into one of the largest and most modern in Britain. To-day, the Grimesthorpe works of English Steel Castings Corporation, one of the ESC subsidiaries, produces steel castings ranging from a few ounces in weight up to 185 tons each. Amongst the heaviest of these are forging-press parts and rolling-mill housings, whilst the lighter range include pressure-resisting castings for turbines, railway and mine-car automatic couplers and cast-steel bogies for railway wagons, and one-piece bogie-frames for carriages and locomotives.

One-piece Bogies

A hundred years ago the predecessor of English Steel Castings Corporation was a pioneer in the development of cast-steel products. Now, the present company is continuing the tradition by developing new methods of manufacture and new applications for steel castings, particularly in respect of one-piece bogies for railway use. An example of this type of production is shown in Fig. 1. It is the first of a series of one-piece driving-truck beds for New South Wales Government Railways' 3,820-h.p. 0-6 + 6-0 electric locomotives, which Metropolitan Vickers-Beyer, Peacock, Limited, are building, and for whom the Corporation are sub-contractors.

The truck beds, of heat-treated steel equivalent to A.R. specification M.201-52 Grade "A," are designed to carry three 1,500-V. force-ventilated motors mounted on each axle. The rail load per axle is 18′ tons, whilst a notable design feature is the mounting of the draw and buffing gear on the truck headstocks. The locomotives, 40 in all, which are for goods or passenger traffic, will be used on lines running over the Blue Mountains, where the track rises from sea level at Sydney to 3,500 ft., with ruling gradients of 1 in 33. Their maximum operating speed is 70 m.p.h.

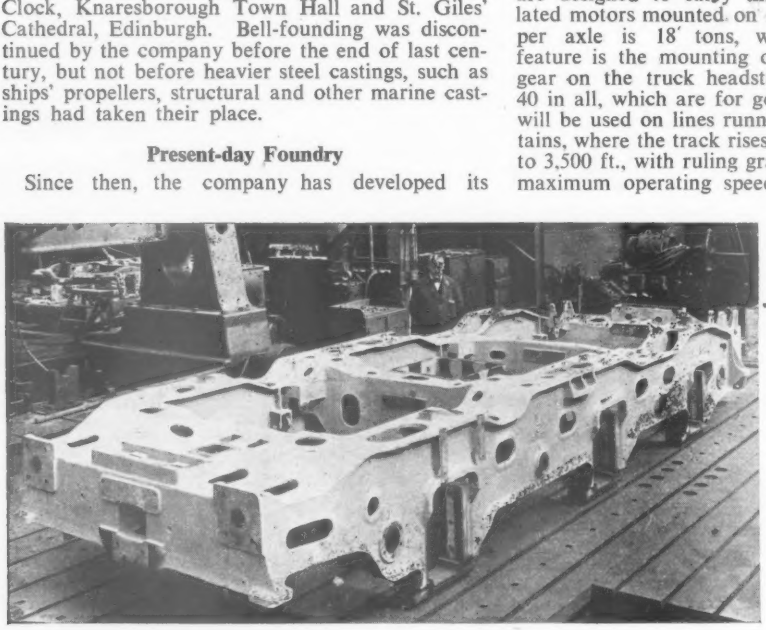


FIG. 1. — *One-piece, cast-steel, three-axle driving-truck bed for New South Wales Government Railways, made by English Steel Castings Corporation, Limited, Sheffield. It is approximately 25 by 8 ft. and weighs 7½ tons.*

A Designer's Viewpoint

Extracts from Mr. K. H. Collinson's Presidential Address

Mr. K. H. Collinson, who is himself a designer, expressed some interesting views on the profession during the course of his presidential address to the West Riding of Yorkshire branch of the Institute of British Foundrymen. The extract below is retained in the "first person" so as to preserve "atmosphere."

I sneaked in at the back door of engineering—the drawing office—and became a draughtsman, and later a designer. You all know, of course, that a draughtsman is a man who rubs out, and he is not much of a draughtsman if he does not rub out a lot! A designer is the man who tells him what to rub out—sometimes they are one and the same man. I like to think that the work I have done in the foundry and with foundrymen for many years past has given me a special understanding of the points of view of those traditional enemies, the foundryman and the designer.

The word "design" is an unfortunate one to use in connection with engineering; in the minds of most people a designer is one who traces pretty patterns for carpets, and has quite exceptional artistic ability. We have a very large and ever expanding literature devoted to the subjects of commercial art, industrial design, and to the problem of increasing the ability of the men in the street to discern between good and bad art, as applied to everyday things. This is not the place, of course, to dilate upon the question of industrial design, but I would like to stress the point that the word "design" is used in engineering in the sense in which we use it when we speak of a "designing woman." What a gift to the writers of romances she is—almost as valuable as the detective in the "who-dun-it"—she tracks down some poor defenceless male and like the "Mounties" and with a charming ruthlessness she always "gets her man"—by design.

And so it is with the creative mechanic, the engineering designer; he tracks down the solution to the mechanical problem put before him, traps it in its lair and captures it with what appears so often to the poor moulder to be a ruthless disregard for his comfort. Then, if some interfering, sales-conscious individual, who thinks his potential customers may be art minded, tells the designer to "make it pretty," it is ten to one the results will make it more difficult than ever for the moulder!

In this connection I would remind you that a sub-committee has been appointed by the General Council of the Institute to study the design of castings, under the able chairmanship of Mr. J. Blakiston. One of the terms of reference is "the preparation of a report which, with the co-operation of the engineering institutions concerned, may be developed into a code of practice." It is unfortunate that designers are far too often (from the point of view of design only, of course!) such ill-mannered people, and a code of behaviour, a book of etiquette, telling the designer what "is" and what "is not" done in a well-conducted moulding society, should be as valuable to the designer as the "Atlas of Defects" published by the French, under the leadership of Mr. Guy Hénon, is to foundrymen.

I have spoken rather disparagingly perhaps of the havoc wrought to foundry economy by the mechanic who is insufficiently acquainted with the fundamentals of moulding limitations, but there is another and very bright side to the picture. It is the creative mechanic, the engineering designer who has used his imagination and special training to bring about the dramatic changes for the better in foundry production methods which are constantly being given to us.

"Automation"

I need not enumerate the many ways in which the engineer is making casting production a branch of engineering, but you would think me a strangely unnatural creature if I did not "trot out" that word that people use to make your flesh creep, like the fat boy in Pickwick—"Automation." It is an unfortunate word because we are a nation of free people, and we dislike and resent the mere sound of "ought to"—we are not going to be told we "ought to" anything. Anyhow, how much will it affect us? There are foundries very near here which have developed mechanization to the nth degree, but do they for one moment, in spite of their astronomical figures of output, believe it can all by done by the application of a finger to a coloured knob? I think they would say no, though I am not competent to judge, and anyhow I am prejudiced, being a mechanic who thinks everything is possible! What a headache I give myself sometimes!

However, there is a very much worse word, though it is not being used very much, because people can't make up their minds whether to pronounce it "kybernetic" or "sybernetics"; it comes from the Greek word meaning "steersman," and as it is of American origin I'm quite sure it should be sybernetics because Americans are further than we are from Greece. It was the name of a book published in 1948 by a Nobel prizewinner named Norbert Weiner, a professor of mathematics—and yet although only a rather "big-head" mathematician could follow its arguments, it became a non-fiction best seller. It deals with the mathematical background from which there has been developed the computer, that diabolical contraption having a magnetic memory that, like the elephant, never forgets—a mechanical "stomach" which digests the toughest of punched cards or tapes and so feeds that brain of electronic bottles which sorts out the

A Designer's Viewpoint

best answer in an instant out of a possible multitude to the questions put to it and uses that answer to control the actions of the self-regulating machine, the S.R.N. Worse than that, it understands what you say to it—if you use the right language—you have to be careful! If you tell it to bring you "that something spade" it might bring you an underdone steak. When I was less than little, I used to be told that silence was golden—we may come to a day when, like the public libraries, our foundry walls will bear an injunction to keep silence—or the machine may bite you!

Monkey Labour

There is yet another type of scientist, a biologist, who puts forward an even more disturbing suggestion—Dr. H. Hediger, in his book "The Psychologist of Animals in Zoos and Circuses," speaks of the possibility of domesticating more animals than we have done up to now. Perhaps he will forgive me if I quote in a free transcription something he says. He speaks of the present domestication of animals for food purposes and as rather inefficient automobiles, but for hardly any other use, and asks if there are no other possible applications? He thinks insufficient attention has been paid to the hand—the monkey's hand, he points out, though not as good as ours, is a remarkable instrument, especially when considered in connection with its eye and brain—and that it would take a pantechnicon to carry the electronic equipment that would be necessary to make a machine capable of, for example, picking the apples from a tree without wrecking the tree, and what kilowatts of power would be needed! A monkey does it on a weight of perhaps 40 lb. and a daily consumption of a pound of nuts!

Mr. Collinson here continued his address by referring to the objectives of the Institute and how best they may be fostered. He contended that it was perhaps better to pre-circulate a lecture to members before a meeting so as to give more time to discussion of prepared questions from the audience.

In another paragraph, he quoted the bye-laws of the Institute to illustrate how member firms could be of immense help to the industry by encouraging their technical staff to take part in research for the Institute and to prepare papers for the benefit and instruction of fellow members.

At the conclusion, Mr. Johnson proposed and Mr. Kershaw seconded an enthusiastic vote of thanks to Mr. Collinson for the address.

Publications Received

Specification for Heavy-duty Electric Overhead Travelling Cranes for Use in Iron and Steel Works. Published by the British Iron and Steel Research Association, 11, Park Lane, London, W.1.

In this edition of the specification, an attempt has been made to reduce the cost and weight of the crane. The wording has been simplified so that buyers of cranes will be supplied with special equipment or features only if these are specifically requested. It is desirable that the duties required of a crane should be more closely specified. It is the responsibility of the buyer to ensure that allowance is made for occasional higher loads and any subsequent upgrading.

Since the issue of the first edition, much experimental work has been carried out on cranes to provide more detailed knowledge of the ranges of stresses and deflection to which cranes are subjected during operation, together with a fuller understanding of the stress distribution in such structures as a whole. These findings have been used in framing the stress and design clauses of the revised specification. In the first edition the permissible stresses were based on a constant fatigue factor. In the latest edition, variable fatigue factors are specified to allow for differing stress conditions in the structure, and for the notch sensitivity of the connections, whether butt welded, riveted or fillet welded.

"Nimonic Alloys"—Design Data. Issued by Henry Wiggin & Company, Limited, Wiggin Street, Birmingham, 16.

Design data on the entire range of Nimonic alloys, including preliminary details of the recently introduced creep-resisting material Nimonic 100, are contained in this new edition of "Nimonic Alloys."

Extensive revisions have been made in this booklet in the light of creep and fatigue test results obtained since the earlier edition was published. For example, 10,000-hour creep data for Nimonic 90 and 95 are included for the first time and the fatigue properties of Nimonic 80A at 700 deg. C. and 750 deg. C. are indicated by means of Gerber diagrams. Long-time creep testing of Nimonic 90 is giving some interesting results, a test-piece stressed at 5 tons per sq. in. and heated continuously at 750 deg. C. having shown a creep strain of less than 1 per cent. in its first 15,000 hours. Other information given on the Nimonic series includes the specified compositions, hardness ranges, physical properties, recommended heat-treatments, short-time high-temperature tensile properties and results of torsion tests.

British Moulding Machine Company, Limited. Issued by the company from Weston Works, Faversham, Kent.

This brochure has been elevated to a "publication" because it cannot be deemed to be a catalogue. It carries no real advertising matter but is essentially confined to publicity. It carries on the inside cover pictorial maps of where installations have been. It opens with beautiful pictures of Faversham and its environs, an aerial photograph of the works and one of the bays in the shops. There are some excellent shots of ships, an aeroplane and Tower Bridge, each of which is associated with exports of the firm's machines. Then follows a pictorial around the world, with one or two pages devoted to each country. They are all of the same pattern—one or two views of the country and one or two pictures of installations, constituting a really fine album. Moreover, except for the outside covers, the book has been produced at Weston Works. Recipients of this brochure can indeed count themselves fortunate.

THE SLUDGE VESSEL Shieldhall, owned by Glasgow Corporation, is to be sold as scrap at a price of £14,250. A new vessel of the same name is to be handed over by the builders this week.

International Enamelling Congress

Countrywide Series of Events End in Edinburgh

The International Enamelling Congress, held in this country from October 9 to 21, coincided with the coming-of-age of the host organization, the Institute of Vitreous Enamellers. The event was fittingly marked by a series of brilliant functions, works visits and excursions between London and Leamington, Birmingham, Lancashire and Scotland, which will be fondly remembered by the hundreds who comprised the British contingents and particularly treasured by the 80 foreign enamellers and their wives, who participated. Tremendous enthusiasm and energetic co-operation were early engendered amongst all who attended, symptoms which were well sustained, even despite somewhat diminished numbers, right up to the closing function in Edinburgh last Friday.

Programme Summarized

The programme was well balanced and provided, along with technical sessions, a series of works visits to enamelling plants and kindred organizations, added to numerous social events, all on a scale unprecedented in the Institute's history. The London proceedings were initiated by a reception for overseas guests and dinner on Sunday, October 9, in the Park Lane Hotel, followed on the Monday by works visits in the metropolitan area and a reception in the evening by the Southern section of the Institute—an extremely pleasant function, also held at the Park Lane Hotel. Tuesday was spent by Congress delegates in travelling to Leamington Spa, visiting the Pressed Steel Company, Limited, at Oxford *en route*. This day was concluded by a reception in the Royal Pump Room, Leamington, at which the Midland section were hosts.

Annual General Meeting

This took place on October 12 in the Town Hall, Leamington. The proceedings followed much on well-established lines. A healthy Balance Sheet was disclosed, and the chairman's (Mr. J. Biddulph's) Report was extremely well received. Mr. C. R. Wheeler was voted president-elect—in the normal course, he will assume high office 12 months hence. The honorary treasurer, Mr. W. S. Grainger, was re-elected for three years, and three members of Council, Mr. A. Biddulph, Mr. H. Whitaker and Mr. S. E. A. Ryder, for a like period. That afternoon was given over to works visits in the Warwick-Birmingham area and in the evening there was a Civic Reception by the Mayor and Corporation of Leamington, followed by dancing.

Thursday saw Congress delegates in technical session in Leamington Town Hall both morning and afternoon, but the evening was spent in lighter vein—a trip to Stratford-on-Avon for dinner, followed by a visit to the Memorial Theatre to see "The Merry Wives of Windsor." In similar manner Friday was spent, but the relaxation in the evening was provided this time by the annual banquet of the Institute, held at Chesford Grange, Sir George Briggs, president of the Institute, and Lady Briggs receiving. The chief guest was Mr. F. J. Errol, Parliamentary Secretary to the Minister of Supply. Dancing until 1 a.m. concluded a most noteworthy and well-attended function (a total of 270 members, their ladies and guests were present).

On Saturday, there was first a short technical session, at which two papers were presented. Then, in the evening, the first week's programme was concluded by a Reception in Birmingham by the president and Lady Briggs.

Second Week

On Monday, October 17, delegates re-assembled in Manchester, first for works visits and then, in the evening for a Reception by the Northern section of the Institute at the Café Royal. More works visits—one to Stoves, Limited, Rainhill, and the other to English Electric Company, Limited, Bradford—occupied the next day, the evening and overnight stay being spent in Morecambe.

A coach tour *via* the English Lakes took delegates and ladies next day pleasantly to Edinburgh for the final phases of their "Cook's Tour"; light relaxation that evening was provided with the Scottish section as hosts. The programme for the next two days followed what was by then a quite well-established precedent, though the changed settings prevented any flagging of interest. On the first of these days, the morning's "plant visitations," which included a number of foundries, were followed in the evening by a most colourful Civic Reception by the Lord Provost and Corporation of the City of Edinburgh.

The evening of the second day in Edinburgh was again devoted to dinner, informal converse and entertainment, but this, in contrast, was perhaps a little sad, since it was the winding-up function of the Congress and farewells and leave-takings—though with many *au revoirs*—had to be made at midnight. This closing banquet was perhaps one of the best of all. The "core" of delegates who had followed the whole of the round of events were by then fast friends, yet local faces were new and Edinburgh founders and enamellers were present in strength. They swelled the company at the George Hotel to close on 100, despite the fact that some members, mainly foreign delegates to the Congress, had reluctantly departed earlier for home. A pleasing feature was the presentation to the assembly at the tables of a souvenir brochure of Scottish scenic panorama and a miniature bottle of the "local distillate." The speech by Mr. Biddulph, who proposed "The City," as was to be expected, was in reminiscent vein, and the response by Baillie Bruce Russell could only echo his closing words "come again." The toast to the "Overseas Visitors" was ably proposed by Mr. R. M. Watters, deputy chairman Scottish section, and the reply was no less ably given (in English) by Mr. Olav Schu̇der of United

International Enamelling Congress

Ironfoundries, Limited, Denmark. Other speakers included Mr. John Gardom who said farewell on behalf of the past-presidents, Mr. Frank Jones of Ohio, who, while returning thanks, invited delegates to visit his plant in America, and, finally, Mr. Biddulph again, who voiced the deep gratitude of all the assemblies of the whole Congress to the secretary, Mr. J. D. Gardom, for his really wonderful organization over the period. A display of Scottish dancing preceded "Auld Lang Syne," to round off what must surely be the most memorable Congress of enamellers of all time.

Although it might perhaps appear that much of the Congress was devoted to pleasurable pursuits, such an impression would indeed convey less than half the picture. In actual fact, no fewer than 16 papers were presented at the six technical sessions, about half being by overseas delegates. In all, 18 British works opened their doors to receive delegates, and in many cases also dispensed hospitality. To the managements of all these concerns, the Institute is indeed much indebted; there is no doubt that friendly interchange of opinion, arising from viewing other people's works and processes, added enormously to the value of the Congress.

Eye Injuries — Heavy Damages

Giving judgment at Birmingham Assizes on October 11, in a case in which a man alleged a breach of statutory duty and negligence against Gaskell & Chambers, Limited, brassfounders and engineers, of Coleshill Street, Birmingham, Mr. Justice Streatfield commented on the reluctance of workmen to wear goggles when doing work which needed protection for the eyes. He awarded £750 damages to Mr. F. Smirthwaite, who claimed a breach of statutory duty on the part of the firm under the provision of goggles and the protection of eyes regulations; and that they failed to provide goggles and caused or permitted him to do work without the use of goggles, and failed to instruct him on the safe method. Mr. Smirthwaite was turning a mould when a piece of metal flew up into his left eye. As a result of the accident the sight of this eye had been considerably impaired.

A Calderbank, near Airdrie, man who lost an eye when a piece of broken wire from a machine entered it, was awarded £625 damages by the Court of Session in Edinburgh. The man, Mr. A. Wells, labourer, sued his former employers, the Speedwell Wire Company, Limited, of Coatbridge, for £2,500. Wells, who was employed as a wire drawer when the accident happened in November, 1952, said he was standing between two wire-drawing machine, of which he had charge, when a small piece of wire entered his left eye. He maintained that the firm failed to take reasonable care for his safety and that they were aware that wire often broke while being drawn and that particles were thrown off. They should have had a sheet metal or fine-mesh guard fitted around the machine or have provided goggles. The firm, denying liability, maintained that they had been advised by the makers of the machines that the only safety precaution necessary was a wire-mesh guard in front. They had no reasonable grounds for anticipating that an accident of this nature would occur. They did not admit that the piece of wire which entered the man's eye came from the machine.

New Catalogues

Electrical Equipment. Foster Transformers, Limited, South Wimbledon, London, S.W.19, have issued three catalogues covering voltage regulating equipment, an electronic constant-voltage transformer (Mark II VR/ECV), and test equipment. They all carry an attractive make-up in green.

Fuel Economy through Refractories. Morgan Refractories, Limited, Neston, Wirral, Cheshire, have just issued a very interesting leaflet, which clearly sets out the fuel economies to be obtained in batch melting furnaces through the use of high-temperature-resisting insulating refractories, because of the property of heat storage.

Calculators. A leaflet from Carbic, Limited, 54, Dundonald Road, London, S.W.19, describes and illustrates the Otis King tubular-type of slide-rule calculator. The *modus operandi* of the instrument is given, along with quite impressive examples of the types of "sums" which can be quickly performed. The working out of metal mixtures or of a percentage from a precipitate weight and a factor might have been added to the examples quoted, for they are typical of many in foundries and laboratories for which slide-rules are a boon.

Limit Switches. J. A. Crabtree & Company, Limited, Lincoln Works, Walsall, Staffs, in publication No. 1158, which is an 8-page illustrated booklet, have not made the best possible use of colour. The inside is so much better than the front, where the use of white is excessive in contrast to the blue. Good balance has been achieved on pages 2 to 5, where pleasing use has been made of pastel shades. Technically, the booklet is excellent, where lucid description is matched by clear illustration. It is available to readers on writing to Walsall.

Molten-metal Pyrometer. The Cambridge Instrument Company, Limited, 13, Grosvenor Place, S.W.1, have issued an illustrated leaflet covering a design of thermocouple immersion pyrometer suitable for use with the various non-ferrous foundry alloys and also cast iron. For many of the former a chromel/alumel thermocouple is used, but for temperatures exceeding 1,100 deg. C.—and this includes cast iron—a rare-metal couple is employed. As indicators, either a wall-mounted instrument or a portable one is available. This leaflet, numbered 18A, is available to readers on writing to the firm, at Grosvenor Place.

Dust and Fume Collection. Publication No. 54 received from W. C. Holmes & Company, Limited, Turnbridge, Huddersfield, deals with a number of plants collectively known as the Schneible Multi-wash System. Amongst the many excellent illustrations in this 24-page brochure is a clear cut-away picture showing the operation of the system. Considerable space is given to various types of de-watering tanks. Towards the end of the brochure, the ventilation of knock-outs is covered. The method shows the utilization of upward currents and introduces a system of louvres to compensate for side draughts. Finally the catalogue describes and illustrates a simple cupola dust- and spark-arrester. The corrosion problem to be associated with the re-circularization of the sulphur containing water is solved by the frequent emptying of the tank. This catalogue is available on writing to Huddersfield.

MUREX WELDING PROCESSES, LIMITED—Mr. J. M. Willey, general manager of the company, has been appointed to the board.

New Equipment

Torch Cutting and Gouging

A new cutting and gouging tool is the heavy-duty patented Arcair equipment which is being produced in this country by the Lincoln Electric Company, Limited, of Welwyn Garden City, Herts., sole concessionaires in Great Britain and Europe. The process is a natural development of carbon-arc cutting, in which an arc is drawn between a carbon electrode and the work, but with the addition that, in this case, a compressed-air supply provides two jets of air from one clamping jaw of the electrode holder and directed axially along the arc so that the cutting action is primarily a physical blowing away of molten metal, although, where iron is part of the metal being cut, some chemical removal by oxidation will obviously take place.

Equipment and Method

The necessary equipment used comprises: (1) a torch having a concentric cable carrying air and current, the torch having self-aligning rotating jaws which permit the electrode being adjusted to any angle, while the handle of the torch is fitted with an air valve; (2) an air supply of between 80 and 100 lb. per sq. in., the higher pressures providing the most effective metal removal, and (3) a standard d.c. motor/generator of at least 300-amp. capacity connected normally for positive polarity. Although electrodes ranging in size from $\frac{5}{32}$ to $\frac{1}{4}$ in., or even $\frac{3}{8}$ in. in some cases, are used at amperages from 200 to 650, the major employment is with electrodes of $\frac{3}{16}$ to $\frac{1}{4}$ in. size at amperages of 325 to 550, so that the SAE-600 machine is the most suitable where an initial installation is being made.

The method of using this equipment is to connect the torch to the generator and air supply, *via* the concentric cable, inserting the electrode in the jaws so that it projects about 6 in. and the air-jet holes point towards the arc. Then, holding the torch so that it slopes backwards from the direction of travel, the air-valve lever is fully depressed and the arc struck. Next, the electrode is pushed into the work into the cut so that it almost touches. Due to the inclination of the electrode, the air jet will strike the work behind the arc so that the angle of the impingement will naturally determine the depth of the groove. It is necessary both for continuity of the cut and for cooling of the torch to ensure that the air control valve is depressed fully all the time. During the cutting, the tendency to draw an arc should be avoided and the electrode should be always pushed into the cut so that it almost touches the work.

Copper-coated graphite carbons have been specially produced for use with the torch, which result in longer life than ordinary uncoated carbon; they carry a much higher current and maintain well their original diameter.

Applications

In the first instance, as this is a physical cutting process, it may be used on all metals which may be melted by the arc and therefore applies to austenitic as well as ordinary steels, hard alloys, brass, bronze, monel and cast iron. Founders have mainly used carbon-arc cutting in the past for the gouging out of defects and the removal of risers and excess metal from austenitic castings and the new method, utilizing compressed air, can replace these applications because of the vastly increased speeds obtainable. It is, however, the fact that the new tool may be used in all positions that really enlarges the scope of the method. This is particularly applicable in foundries making the larger components, say, up to 30 tons. Here, fettling and repair application includes ladles, rail-car bogies, press-frames, austenitic manganese-steel tank-hulls and turrets, locomotive castings, etc. All these, because of their size, call for removal of metal, not only in vertical and overhead positions, but also in enclosed spaces where the ordinary carbon arc would not operate. Obviously, the tool may also be used for a wide variety of maintenance work in foundries (Fig. 1).

Fig. 1.—*Arcair gouging tool being used preparatory to repairing a pump casing*

Dust Conveying

Pneumatic transport of solids usually entails high capital and running costs, even with a well-designed system. These costs can be excessive in dust-extraction and collection installations where the volume of contaminated air that has to be entrained into a plenum system to ensure satisfactory ventilation far exceeds the volume of air required for the pneumatic transport of the particulate matter suspended in the entrained air.

In dust-extraction systems prepared by Dallow Lambert & Company, Limited, Spalding Street, Leicester, where the collected dust has to be conveyed an appreciable distance to the final disposal point, it is claimed that this tendency has been mitigated to some extent by siting the dust separator as near as possible to the area of extraction and employing an independent pneumatic transport system to carry the dust to the disposal point. The collected dust is fed into the secondary system by means of a venturi throat. Only the minimum amount of air necessary to prevent dust settling in the ducts is used and this is much less than the volume of air originally entrained, resulting in savings in power and capital costs. Furthermore this air can be drawn from outside the building and is therefore clean, thus avoiding wear and abrasion on the fan impeller..

New Equipment

New David Brown Products

New addition to the existing range of David Brown "Coventry" geared motors is the Size 4 model, available in double or triple reduction form, and designed to transmit input horsepowers from 4 to 15. With motor speed of approximately 1,425 r.p.m., any one of an extensive selection of output speeds, ranging from 25 to 345 r.p.m., can be obtained.

Another standard product which has been extended in range by the David Brown companies is the S-type floating reamer. Hitherto available in 14 sizes from ¾ in. to 4 in., the range has now been extended by the addition of nine new sizes, giving an overall coverage of ½ in. to 8 in.

A new 40/45 b.h.p. David Brown marine diesel engine is also announced. Designated the MD 6, it is a six-cylinder version of the David Brown MD 4, a high percentage of parts being common to the two engines. The MD 6 unit, like the latest version of the MD 4, has a 3⅝-in. bore and 4-in. stroke, overhead valves, and direct injection, with a compression ratio of 15.9:1. Its capacity is said to be 4,059 cub. cm. and the full-load speed range is 800/1,800 r.p.m.

Double-ended Grinder

Beacon Machine Tools, Limited, Hurst Lane, Tipton, Staffs, have designed a 16-in. high-speed double-ended dry grinder, which embodies the dust-control system (Fig. 2) evolved by the British Cast Iron Research Association, and is manufactured under licence. The machines use high-speed Resinoid-bonded wheels operating at 9,000 surface ft. per min. There are two spindle speeds for coping with wheel wear, the need

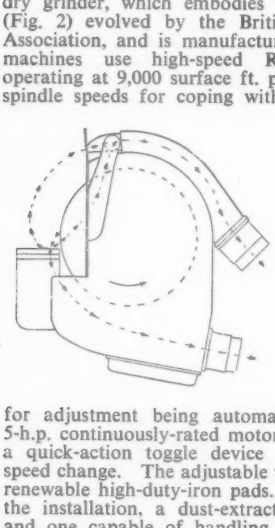


FIG. 2. — *Diagram showing the system of external dust control adopted by Beacon Machine Tools, Limited.*

for adjustment being automatically revealed. The 5-h.p. continuously-rated motor is hinge-mounted, with a quick-action toggle device to facilitate this wheel speed change. The adjustable work-rests are fitted with renewable high-duty-iron pads. Naturally, to complete the installation, a dust-extraction system is required, and one capable of handling 1,400 cub. ft. per min. against a 10-in. total water column is recommended.

Belark Soldering Tool

A new soldering tool, which is particularly applicable to joining aluminium, was demonstrated recently in London. Made by Belark Tool & Stamping Company, Limited, 33, Sussex Place, London, W.2, it combines an electric heater for the head with an electric vibrator on the handle shank, which actuates a wire brush for the mechanical cleaning of the metals to be "tinned." When joining aluminium it is essential that no oxidization takes place between the operations of cleaning and tinning. The new tool carries out these two operations simultaneously. Cleaning of surfaces is carried out by the vibrating steel-wire brush located in the centre of the solder bit. Designed for use in mass-production or repair operations, it can be handled by unskilled persons; no flux and no additional heat is necessary when joining sheet metal of normal gauges. The tool is supplied with two interchangeable solder-bits, one for flat surfaces and one for corners and inside faces.

Method of Use

After the tool is switched on, it takes a few minutes to heat up. The bit is then placed in a vertical position on the aluminium surface and a high-tin solder applied until a pool of molten solder has formed round the bit. The vibrating brush is then brought into action by pressing a trigger and the tool is moved over the surface to be tinned. The pool of molten solder around the area being scratch-brushed effectively prevents oxidization and permits proper tinning. Jointing is then carried out as in normal soldering, bringing together two components after tinning for joining them or adding more solder if building-up of a surface is required. To ensure a trouble-free life and to prevent corrosion, all essential parts are made of stainless steel, and the copper-bits have a coating of nickel and hard chrome. Types are available to suit 110 200-220 and 225-250-v. electricity supplies. The solder recommended for use with the tool is an 80/20 tin/zinc alloy. For such operations as the repair, re-shaping or building-up of aluminium patterns, this tool would seem particularly suitable. When dealing with fairly massive items, such as castings, moderate preheating of the base metal is recommended, as for ordinary soldering.

FIELDEN ELECTRONICS, LIMITED, of Paston Road, Wythenshawe, Manchester, 22, have recently introduced a low-priced recorder known as the Servograph mark 11. This extremely versatile instrument is said to be suitable for direct operation from *p*H meters, CO_2 indicators, smoke-density meters, Beta gauges, tachometers and many other uses as well as being a recording voltmeter and ammeter.

Allied Ironfounders in Australia

The new foundry set up by Allied Ironfounders (Pty.) near Melbourne, Australia, is now ready to start production. From the parent company in Britain, 25 key craftsmen, with their families, are being transferred to Melbourne, and to mark the occasion a farewell party was held at the Aga Works, Ketley, Shropshire, on October 24. The Hon. Sir John Lienhop, Agent General for Victoria, addressed the gathering. He was accompanied by Lady Lienhop, who took part in the ceremony and was specially interested in meeting the children. Sir John Lienhop said that this new enterprise was a triumph of practical Empire decentralization; also a wonderful contribution to Empire security.

Greetings from the Premier of Victoria were read at the gathering. The Lord Lieutenant of the County of Shropshire, Maj.-General Viscount Bridgeman, C.B., D.S.O., M.C., Lieut.-General Sir Oliver Leese, the Members of Parliament in whose constituencies the emigrating families have worked, were present, as were the civic heads of the district. Mr. J. Shaw, chairman of Allied Ironfounders, Limited, and the managing director, Mr. W. T. Wren, wished good luck to the departing families. Preparations have been made to receive them in new homes at Clayton, 15 miles from Melbourne.

Personal

MR. JESSE WOOD has been appointed a director of Moler Products, Limited, Colchester, Essex.

MR. M. J. REANEY, general manager, Colt Ventilation, Limited, has left London for another trip to the United States.

MR. JAMES R. NUTTALL has been appointed assistant secretary to the Brightside Foundry & Engineering Company, Limited, Ecclesfield, Sheffield.

Mr. R. W. EVANS, superintendent of the Steel Company of Wales, Limited, has been installed as president of the Swansea and District Metallurgical Society.

Mr. HERBERT HINDLE, who has worked for the David Brown group as a patternmaker for 50 years, has been presented with a gold watch by Mr. G. L. Hancock on behalf of the directors.

Lord POLWARTH is to succeed Lord BILSLAND as chairman of the executive committee of the Scottish Council (Development & Industry). Lord Bilsland will continue to be president of the Scottish Council.

F. PERKINS (CANADA), LIMITED, Toronto, the Canadian company belonging to F. Perkins, Limited, diesel engine manufacturers, of Peterborough (Northants), has appointed Mr. P. ALLISTON as its commercial manager.

BRITISH OXYGEN ARO EQUIPMENT, LIMITED, the new company providing a link between the British Oxygen Company, Limited, and the Aro Equipment Corporation, of the USA, has appointed Mr. R. J. FOSTER as its general manager.

Mr. MARTIN VULLIAMY, chief experimental engineer of F. Perkins, Limited, diesel engineers, of Peterborough, has been installed as president of Peterborough Engineering Society. He succeeds Mr. G. D. WILSON, a director of Baker Perkins, Limited.

THE Brazilian Government has decorated Sir IVOR COX, deputy chairman of the Metropolitan-Vickers Electrical Export Company, Limited, and managing director of Associated Electrical Industries (Overseas), Limited, with the Order of the Southern Cross.

Mr. L. R. PARKES has relinquished his position as publicity manager of Horseley Bridge & Thomas Piggott, Limited, constructional engineers, etc., of Tipton (Staffs), to join the publicity staff of the A. P. V. Company, Limited, London, S.W.18. He has been succeeded by Mr. N. J. GRIGG.

Mr. P. L. JONES, a director of Swan, Hunter, & Wigham Richardson, Limited, Newcastle-upon-Tyne, was elected chairman of the National Association of Marine Enginebuilders last week. Mr. JAMES FERRIER, chairman and managing director of Rankin & Blackmore, Limited, Greenock, was elected vice-chairman.

Mr. JAMES MARSHALL, who has been employed in the enamelling department at Bonnybridge foundry for the past 31 years, 20 years as foreman, was recently presented with a wallet of notes from the directors, foremen and supervisory staff of Smith & Wellstood, Limited, on the occasion of his retirement at the age of 65.

THE MEMBERSHIP of the Atomic Energy Authority has been brought up to its limit of 10, other than the chairman, with the appointment of Mr. W. STRATH, at present serving as a Third Secretary at the Treasury, as a full-time member, and Sir ROWLAND SMITH, chairman of the Ford Motor Company, Limited, and Mr. C. F. KEARTON, as part-time members.

House Organs

Wild-Barfield Heat-treatment Journal, Vol. 5, No. 36, a group publication from Electfurn Works, 1, Watford By-pass, Watford, Herts.

This issue contains as its major item of interest to JOURNAL readers a lengthy article on electric furnaces for vitreous enamelling, emanating from G.W.B. Furnaces, Limited. Other information is included in the issue on a high-frequency hardening machine, gas-carburizing practice and electric furnaces for spheroidizing—the latter as applied to ball-bearing steels.

Fedrex Inspection Bulletin. Issued by Carl Drenck, Copenhagen, N., Denmark.

This is the first issue of a news bulletin covering industrial X-ray sets, which are supplied in this country by the British representatives, Inspection Equipment, 19, Broad Court, Drury Lane, London, W.C.1. Copies of the Bulletin may be obtained by readers who write to the London address.

Obituary

Mr. THOMAS DUDLEY, managing director of Thomas Dudley, Limited, Tipton, died on October 12 at the age of 76. Mr. Dudley founded the business in 1920 and had been in the ironfoundry trade for 58 years.

Mr. ALEXANDER GOW, formerly secretary of the Imperial College of Science and Technology, London, has died at the age of 86. He was appointed secretary of the College in 1908, retiring in 1934. In 1946 he was elected an honorary fellow.

Mr. ARTHUR HAROLD LLOYD, who has died at the age of 70, was director of design with Alfred Herbert, Limited, of Coventry. He joined the company in 1905, working in the toolroom under a foreman who became Sir Harry Harley. His design work in the first world war gained him the MBE. Mr. Lloyd joined the board of the company in 1923 and became works director three years later.

Mr. E. B. WALKER, who died recently in his 72nd year, was, until his retirement in 1953, technical director of Walker Bros. (Wigan), Limited, engineers and ironfounders. Mr. Walker joined the company in 1903 as an apprentice, and completed 50 years' unbroken service. He was appointed a director in 1920 and technical director in 1943. His particular interest was the supply of large ventilating plant for mines and tunnels.

THE DEATH has occurred of Mr. FREDERICK RUSHTON, managing director of the Hanley Foundry Company, Limited, at the age of 65. A native of Bucknall, Mr. Rushton joined R. Goodwin & Sons (Engineers), Limited, Ivy House foundry, as an apprentice when he left school, and became a director of the firm before starting the Hanley Foundry Company, Limited, in 1946. He was a prominent member of the North Staffordshire Ironfounders' Association.

THE DEATH is announced of MR. ERNEST GERALD KING, chairman of the Louis Cassier Company, Limited —a subsidiary of Associated Iliffe Press. He was 78. Mr. King entered journalism in 1894 when he joined the London staff of an American journal, "Cassier's Magazine," devoted to engineering and shipbuilding in all its branches. Later, a number of other publications were introduced, including *Metal Industry* and *Iron and Steel*. In 1942, Mr. King handed over the control of the company to Associated Iliffe Press.

News in Brief

DALLOW LAMBERT & COMPANY, LIMITED, have changed their address to Thurmaston, Leicester; telephone: Syston 86931.

ELCONTROL, LIMITED, 10, Wyndham Place, London, W.1, are to move into a new and larger factory next door to their present site at Hitchin.

IN RESPONSE to a wide demand, Kodak, Limited, Wealdstone, Harrow, Middlesex, are now marketing the well-known Kodak " Plus-X " film in sheet form.

THE MANAGEMENT COMMITTEE and the four technical sessions of the *Bureau International de la Récupération* (B.I.B.) is to meet in Brussels to-day and to-morrow.

RETSAM COMPANY, LIMITED, brassfounders, 28, Newhall Hill, Birmingham, 1, has had plans drawn up for the erection of new extensions to their premises at 18-30, Lyng Lane, West Bromwich.

TWENTY-FIVE MEMBERS of the Brush Student Association, Loughborough, recently visited the B.S.A. works at Birmingham, where they made a tour of the showrooms and many sections of the factory.

THE RUGBY TURBINE factory of the British Thomson-Houston Company, Limited, is being re-equipped and expanded, consequent upon the transfer of manufacture of the larger units—30 MW and over—to the works at Larne.

THE FIRST full-scale conference on work-study to be organized by the Glasgow Productivity Committee is to be opened on November 1, at the Central Hotel, Glasgow, and will continue for five days, with the help of the British Productivity Council's work-study unit.

IN A RECENT NOTE covering the display (in the Strand window of the Western Australian Government) of goods to be made in the Australian factory of Allied Ironfounders, Limited, it was inadvertently stated that baths were to be manufactured. This is not the case.

VAUXHALL MOTORS, LIMITED, have placed an order with the Atlas Diesel Company, Limited, Wembley, for the supply of seven type AR 9 compressors. The units, which will be powered by Bruce Peeble's synchronous motors, give a free-air delivery of 3,220 cub. ft. per min.

MANY INDUSTRIES in the Swansea area were in urgent need of skilled engineering workers, it was stated at a recent meeting of Swansea and District Employment Committee. The unemployed register was at its lowest, and those on it were mainly people changing one job for another.

A CONTRACT for a boiler worth £600,000 has been received by International Combustion, Limited, Derby, from the Central Electricity Authority. The boiler will go to the Poole (Dorset) power station, for which the company has already supplied eight other boilers. The cost of the nine boilers exceeds £5,000,000.

THE General Electric Company, Limited, is planning an expansion programme throughout Australia worth £A1,000,000, the Australian company's chairman, Mr. T. E. Morgan, announced in Sydney on his return from a business trip to the UK. The programme had already been started and would extend over the next two years, he added.

PRODUCTION has been boosted in factories and workers' relations improved through bright and attractive colour schemes, said Sheffield's Lord Mayor, Alderman J. Curtis, recently, when he opened an exhibition, sponsored by the National Federation of Master Painters and Decorators in England and Wales, in the Edmund Road Drill Hall.

THE LARGEST multi-tubular boiler to be built by Cochran & Company, Annan, Limited, is being erected at the atomic station at Chapelcross, Annan. The oil-fired boiler will heat the huts and the entire domestic side of the encampment. It is 10 ft. dia., 25 ft. high, and with a 120-lb. working pressure gives 10,000 lb. of steam an hour.

DAMAGE estimated at £1,000 was caused by a fire which broke out in the office block at the works of Follsain-Wycliffe Foundries, Limited, Lutterworth, Leics, on October 14. Several of the workmen at the foundry are retained firemen and they fought the fire until their brigade arrived. Production will not be affected and only a few documents were destroyed.

THE FOUNDRY of Light Production, Limited, a subsidiary company of Sheepbridge Engineering, Limited, at Slough Trading Estate, Buckinghamshire, has been completely mechanized over the past two years and production has been augmented by 75 per cent. New installations include machines for making piston castings, bulk melting of metal and an oil-fired furnace system.

WORTH more than £200,000, an order has been received by the Power-Gas Corporation, Limited, from Laporte Chemicals, Limited, Luton (Beds), for a Hercules reforming plant to produce high-purity hydrogen. The plant will consist of a reforming furnace followed by three stages of carbon monoxide conversion and carbon dioxide removal, with methanation and a Wiggins gasholder.

OFFICIAL FIGURES issued recently indicated that more than £1 million of orders for merchandise on the restricted import list had been won at the British Trade Fair at Copenhagen, which ended on October 16. Orders for articles on the " free list," covering about 84 per cent. of overall Danish imports. have not been recorded. It is estimated that there were some 500,000 visitors to the Fair.

OVER 200 managing directors and general managers will be attending the second annual dinner of the Institute of General Managers at the Savoy Hotel, London, on December 9, at which the former Prime Minister of the Commonwealth of Australia, the Rt. Hon. the Viscount Bruce of Melbourne, P.C., C.H., M.C., F.R.S., chairman of the Finance Corporation for Industry, Limited, will be the principal guest

FIRMS which have recently taken stands at the permanent exhibition of the Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, include Belliss & Morcom, Limited, who are displaying a fully-equipped instructional steam-turbine plant, specially designed for the use of colleges and technical schools, and Victa Engineering Company, who have installed an example of the Eagle surface grinder.

THE UNITED STATES DEPARTMENT OF STATE has announced that by direction of President Eisenhower, a United States Mission to the European Coal and Steel Community is to be set up in Luxembourg. It will be headed by Mr. W. Walton Butterworth, hitherto Minister and Deputy Chief of Mission in London, and United States Ambassador to Sweden from 1950 to 1953. The date of President Eisenhower's directive was September 23.

A THREE-DAY EXHIBITION showing a range of hand- and machine-made castings in grey, spheroidal-graphite, and special alloy irons was held at the McLellan Galleries, Glasgow, recently, by Robert Taylor & Company (Ironfounders), Limited, of Larbert. One of the exhibits was a special casting used for jet aircraft; it is replacing the light-alloy material normally used, thus allowing aircraft designers to cater for operation at higher temperatures.

THE FEDERATION OF BRITISH INDUSTRIES, after consultation with its counterpart in Austria (*Vereinigung Osterreichischer Industrieller*), recently sent a mission to Vienna to offer its help in connection with the re-equipment of factories and public services now restored to Austrian control under the recent State Treaty. The leader of the mission was Sir John Duncanson. The members of the mission proceeded independently to Vienna, and spent two days in conference.

A GIANT PRESS, built in Chicago, weighing 120 tons with 1,000 tons capacity, is soon to be put into operation at the headquarters of the Production Engineering Research Association. The press, which cost about £50,000, has been entrusted to PERA under American conditional aid. It is to be used for important research into impact extrusion, the method of metal forming which holds promise of considerable saving in materials, time and labour, in the production of heavy components.

THE AIRCRAFT CARRIER HMS Indomitable is to be broken up at Faslane. The carrier, which has a displacement of 23,500 tons, was handed over by the Admiralty to the BISC (Salvage), Limited, last month, and allocated by them to Metal Industries (Salvage), Limited, at Faslane. This contract will provide 12 months' work for the men at Faslane, where two other vessels, the passenger liner Esperance Bay and the former Royal yacht Victoria and Albert are being scrapped.

SOME fifty delegates to the International Enamelling Congress visited R. & A. Main's Gothic Works, Edmonton. Led by Mr. A. Biddulph, chairman of the Institute of Vitreous Enamellers, the party, which included many overseas delegates, spent the morning in touring the foundries, press shop, fitting shop and the enamel shop and its associated departments, after which they were entertained to luncheon by the directors of the firm and its associate, Main Enamel Manufacturing Company, Limited.

THOMAS FIRTH & JOHN BROWN, LIMITED, Sheffield, have made a gift of £1,300 a year for seven years to Sheffield University to augment the endowment of the Firth scholarship. Offered as a jubilee gift it was accepted by the University Council at their meeting on October 21. The Firth Scholarship is the University's oldest entrance scholarship and it now becomes the most valuable. It was created from a fund raised in honour of Mark Firth at the opening of the Firth College from which the University grew.

AT the annual general meeting of Triplex Safety Glass, Limited, Sir Graham Cunningham, the chairman, said that under the " Manzoni scheme " of slum clearance in Birmingham, two of the factories near the centre of the city belonging to the subsidiaries acquired in 1950, were scheduled for demolition and that a new factory would have to be built. With reference to his recent visit to Hamburg, Sir Graham said that a " careful comparison " between British and German man/hours and rates of pay showed that " on the whole there was very little difference between them."

GLASGOW UNIVERSITY is this year offering for the first time a course in nuclear engineering. The course has been devised to equip the practising engineer with an insight into the problems which may be expected to arise when nuclear fission is used as a source of heat to drive electrical generating plant. It will form part of the normal B.Sc. degree course, as one of the additional subjects, and will be offered in the first instance to final year students of electrical and mechanical engineering; suitably qualified engineers who are already in the industry will also be admitted to the course.

AS THE MANY USES of zinc-alloy die-castings in building are often concealed by their decorative finish, the Zinc Development Association, have made a special feature of such items in their display at the Building Exhibition (Olympia, November 16 to 30). The castings displayed include window fasteners, door locks, postal knockers, bathroom fittings, electrical-conduit fittings and timber dowels. Die-casting in zinc alloy is a quantity-production process yielding strong castings with close tolerances and a good, non-rusting surface that can be finished in many attractive ways. Many of the exhibits carry the British Standards Institution's " Kite " mark, guaranteeing that they comply with B.S. 1004.

ON STAND 390, row 7, Empire Hall, ground floor, at the 1955 Building Exhibition (Olympia, November 16 to 30), the Atlas Diesel Company, Limited, will display a range of portable compressors and pneumatic tools and equipment. One item is the LSS 61 grinder and sander, weighing 6 lb. and another, the RS 9 pneumatic saw for cutting timber, etc. The largest exhibits will be two portable compressors, the NT 7 and the NT 9. The former, powered by an Armstrong-Siddeley air-cooled engine, gives a free air delivery of 63 cub. ft. per min. and the latter combines a free-air delivery of 110 cub. ft. per min. with the low weight of 27 cwt.

FOR NATIONAL INDUSTRIAL SAFETY WEEK, the Birmingham and district Industrial Safety Group has launched a campaign to teach women in industry " to learn to earn with safety." The Group believes that whereas men are becoming more safety minded in factories, women are not yet alive to the need for accident prevention. Mr. G. D. Lovell is chairman of the special committee organizing the campaign, which includes an exhibition and film shows at the Group's centre in Newhall Street, Birmingham. In the Sheffield area, firms are taking part with posters and displays of safety clothing. English Steel Corporation, Limited, have sent out 600 letters asking them to participate in the campaign.

FOLLOWING A LUNCHEON MEETING attended by members of the National Association of Malleable Ironfounders on October 17, Dr. J. G. Pearce, of the British Cast Iron Research Association, gave an address on the work of that organization. In his opening remarks, he invited firms to consider membership, pointing out that there was no subscription required though he admitted the Association welcomed donations. Enquiries were dealt with in confidence and without charge, in most cases; the main activities came under the heading of research and development, the collection and distribution of information. During his address, Dr. Pearce stressed work being carried out on foundry atmospheres and productivity and gave an outline of how BCIRA could help in this matter.

RESEARCH on methods of manufacturing bolts, screws, rivets and studs from titanium has been undertaken by Guest Keen and Nettlefolds, Limited. The GKN group research laboratory at Ettingshall, near Wolverhampton, has been engaged on the project and the Smethwick and Darlaston factories will make the new products. Dr. R. T. Alsop, of the metallurgy department of the laboratory, has stated that two major problems have been overcome. They were the lubrication of tools to prevent the titanium sticking to them, and the method of putting threads on the screws. Techniques of producing threads by rolling have been developed and machinery methods are being studied. Titanium produced by ICI at the Witton, Birmingham, plant is now nearing the rate of 1,500 tons a year.

Raw Material Markets

Iron and Steel

Pig-iron production reached its highest peak of the year last month, but the aggregate requirements of the steelworks and foundries have not yet been overtaken, and had it not been for the regular arrival of consignments from the Continent, bought in the early summer months, the shortage would be much more acute. The additional blast furnace recently started in the Midlands has brought the supply of high-phosphorus iron into balance, but specifications for hematite and low- and medium-phosphorus grades cannot be promptly covered. The steelmakers' most clamant need is for more basic iron and the starting of some new blast furnaces now nearing completion is eagerly awaited.

In the re-rolling industry much more favourable conditions have recently developed. Earlier in the year some of the mills were working irregularly because of a lack of orders. Then, when business revived, supplies of steel semis were scarce, but this difficulty has now been overcome. Distribution of home produced and foreign billets, blooms, and slabs is on a reasonably adequate scale, and although the labour shortage is creating difficulties, re-rollers are turning out big tonnages of bars and light sections for which there are assured markets at home and abroad. Wire rods are at a premium.

Rollers of heavy finished products are engrossed with the fulfilment of orders in hand, and buyers who, through improvidence or unexpected events, find themselves in need of prompt supplies, seldom get a favourable response to their pleas. Most of the new orders accepted relate to deliveries in either the first or second quarters of next year.

Non-ferrous Metals

Copper for early delivery on both sides of the Atlantic remains in good demand. Buying in the United Kingdom tends to be patchy, but pressure to obtain nearby supplies in the United States is strong and if more metal were available it could easily be absorbed. Already the price decline on the London market has led the Chilean Government to give further consideration to its original declaration on copper exports, which, in effect, was to supply Europe with about 65 per cent. of her available production, leaving the balance to be allocated between the home market and the United States. Any *volte-face*, however, has little significance, as Chilean production is earmarked for the next eight months. Chibuluma, the new Copperbelt producer in the Rhodesian Selection Trust group, commenced hoisting last week. The ore will be stockpiled for the next few months, pending the completion of the concentrator.

Tin has been a good market. In London the price rose on the news of the strike of African labour in the Nigerian tinfields; in New York, the market was firm on this and on the disclosure that US tin consumption in August was the largest since January, 1951. Moreover, Malayan production in September declined for the first time since June, although total output for the first nine months of the current year is still ahead of the comparable figures achieved last year.

Lead continues to be in demand here and the price remains firm. In the States, buying is strong and there is even talk of a further price increase. In this event, it should only cause a slight hardening in the London price, as there is no shortage of the metal in Europe.

The US zinc market has sprung a surprise. A split price developed last week after Eagle Picher, New Jersey Zinc, and St. Joseph Lead raised their price for the "Prime Western" grade by ¼ cent to 13½ cents per pound, without carrying the rest of the major producers, particularly American Smelting & Refining, which continued to offer the metal at 13 cents. However, over the weekend the difference disappeared when it was announced that the three companies would rescind the ¼ cent increase. Price uniformity now prevails for "Prime Western," but American Smelting & Refining has raised the premium charged for special high-grade metal by ¼ cent, bringing the price to 14¼ cents a pound. There was a strong case for such a move and New Jersey Zinc came into line immediately and other producers were expected to follow.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* October 20, £351 to £352; October 21, £353 to £355; October 24, £355 10s. to £357; October 25, £356 10s. to £357; October 26, £357 10s. to £358.

Three Months: October 20, £339 10s. to £340 10s.; October 21, £341 to £342; October 24, £343 10s. to £344 10s.; October 25, £344 to £344 10s.; October 26, £345 10s. to £346.

TIN, Standard—*Cash:* October 20, £760 to £761; October 21, £761 to £762; October 24, £763 10s. to £765; October 25, £766 to £767; October 26, £771 10s. to £772.

Three Months: October 20, £749 to £749 10s.; October 21, £750 10s. to £751; October 24, £751 10s. to £752 10s.; October 25, £752 10s. to £753; October 26, £754 to £754 10s.

LEAD—*Second half October:* October 20, £106 15s. to £107; October 21, £107 to £107 2s. 6d.; October 24, £107 to £107 5s.; October 25, £107 to £107 5s.; October 26, £106 17s. 6d. to £107.

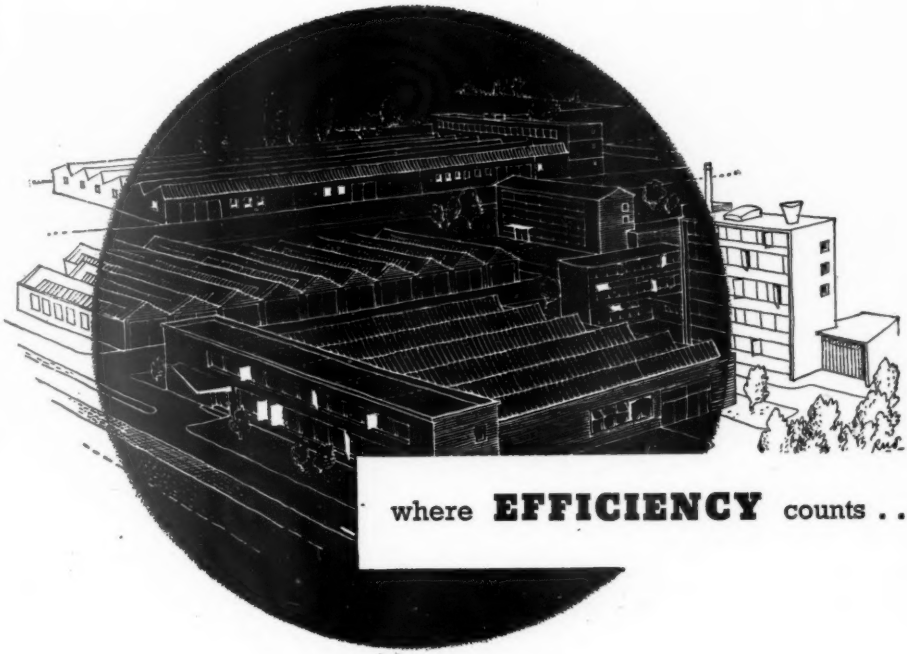
Second half January: October 20, £106 10s. to £106 15s.; October 21, £106 15s. to £107; October 24, £106 15s. to £107; October 25, £106 15s. to £107; October 26, £106 10s. to £106 15s.

ZINC—*Second half October:* October 20, £91 10s. to £91 15s.; October 21, £91 to £91 5s.; October 24, £91 to £91 5s.; October 25, £90 15s. to £91; October 26, £90 10s. to £91.

Second half January: October 20, £91 to £91 5s.; October 21, £90 10s. to £90 15s.; October 24, £90 10s. to £90 15s.; October 25, £90 10s. to £90 15s.; October 26, £90 5s. to £90 10s.

A SALES CONFERENCE was held by George Kent, Limited, at Luton on October 12 and 13, where plans were discussed for the further expansion of home and export marketing beyond the present record levels. Representatives from their world-wide organization were present.

RESEARCH by the British Non-ferrous Metals Research Association for Sheffield Corporation Waterworks Department, has revealed that hot-pressed duplex brass fittings in contact with Sheffield water block up too quickly to be satisfactory. These fittings have been installed in Sheffield's post-war houses but many complaints led to investigation and large numbers are now being replaced. The alkaline water of Sheffield causes zinc to decompose and block the fittings and because of the large numbers involved, facilities for testing were given to the Research Association on various alloys at Redmires filter station. It was found that the hot-pressed duplex fittings block up in 12 to 18 months. The manufacturers hope to produce an alternative fitting.



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Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

October 26, 1955

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £17 1s. 0d.; Birmingham, £16 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £18 12s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £19 8s. 3d.

Scotch Iron.—No. 3 foundry, £19 5s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £21 3s. 0d.; South Zone, £21 5s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £22 0s. 0d.; South Zone, £22 3s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent. :—N.-E. of England (local iron), £19 5s.; Scotland (Scotch iron), £19 11s. 6d.; Sheffield, £20 12s. 0d.; Birmingham, £20 19s. 6d.; Wales (Welsh iron), £19 11s. 6d.

Basic Pig-iron.—£16 16s. 6d. all districts.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £43 15s. 0d., scale 15s. per unit; 75 per cent. Si, £65 0s. 0d., scale 16s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £230 0s. 0d.; 38/40 per cent., £279 0s. 0d.

Ferro-tungsten.—80/85 per cent., 18s. 5d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 21s. 5d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £85 0s. 0d. to £90 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. to 30s. 0d. per unit; over 6 per cent. C, £82 0s. 0d. to £86 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; 2 per cent. C* 1s. 11¾d. per lb. Cr.; 1 per cent. C,* 2s. 0¼d. per lb. Cr; 0.15 per cent. C,* 2s. 2¼d. per lb. Cr; 0.10 per cent. C,* 2s. 2¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £249 0s. 0d.; 96/98 per cent.. £269 0s. 0d.

Ferro-columbium.—60/75 per cent., Nb + Ta, 28s. per lb., Nb. + Ta.

Ferro-manganese (home).—78 per cent., £54 10s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £26 19s. 0d.; tested, 0.08 to 0.25 per cent. C, £27 19s. 0d.; hard (0.41 to 0.60 per cent. C), £29 5s. 6d.; silico-manganese, £36 7s. 6d.; free-cutting, £31 0s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £34 12s. 0d.; silico-manganese, £36 7s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £31 11s. 0d.; basic, hard, over 0.41 up to 0.60 per cent., C, £32 13s. 6d.; acid, up to 0.25 per cent. C, £35 12s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £33 1s. 6d.; boiler plates (N.-E. Coast), £35 11s. 6d.; floor plates (N.-E. Coast), £34 10s. 6d.; sectional material, N.-E. Coast, £30 19s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £33 19s. 6d.; flats, 5 in. wide and under, £33 19s. 6d.; hoop and strip, £35 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £36 5s. 0d.; black sheets (hand mill), 17/20 g., £46 13s. 6d.; galvanized corrugated sheets, 24 g., £58 11s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £58 0s. 3d.; nickel-chrome, £81 10s. 0d.; nickel-chrome-molybdenum, £92 7s. 6d.

NON-FERROUS METALS

Copper.—Cash, £357 10s. 0d. to £358 0s. 0d.; three months, £345 10s. 0d. to £346 0s. 0d.; settlement, £358 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 3s. 4¾d. per lb.; rods, 395s. 3d. per cwt. basis; 20 s.w.g., 428s. 6d. per cwt.

Tin.—Cash, £771 10s. 0d. to £772 10s. 0d.; three months, £754 0s. 0d. to £754 10s. 0d.; settlement, £772 10s. 0d.

Lead (Refined Pig).—Second half October, £106 17s. 6d. to £107 0s. 0d.; second half January, £106 10s. 0d. to £106 15s. 0d.

Zinc.—Second half October, £90 10s. 0d. to £91 0s. 0d.; second half January, £90 5s. 0d. to £90 10s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £122 10s. 0d.; rolled zinc (boiler plates), all English destinations, £120 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £103 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 8¾d. per lb.; rods, drawn, 3s. 6d.; sheets to 10 w.g., 345s. 6d. per cwt.; wire, 3s. 3¾d.; rolled metal, 331s. 3d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £216; B6 (85/15), —; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £270; HTB2 (38 tons), £278; HTB3; (48 tons), —.

Gunmetal.—RCH, 3/4 per cent. tin, —; BS1400, LG2 (85/5/5/5), £307; LG3 (86/7/5/2), £319; G1 (88/10/2/½), £384; (88/10/2/1), £371.

Phosphor Bronze.—BS1400, PB1 (AID released), £395 per ton.

Phosphor Bronze Strip, etc.—Strip, 484s. 0d. per cwt.; sheets to 10 w.g., 507s. 0d. per cwt.; wire, 4s. 1¼d. per lb.; rods, 4s. 3¾d.; tubes, 4s. 2d.; chill cast bars: solids 4s. 4½d., cored 4s. 5½d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 2¾d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 7½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 6½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 4d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £91 0s. 0d. to £91 10s. 0d. Nickel, £519 0s. 0d. Aluminium, ingots, £171 0s. 0d.; aluminium bronze, (BS1400), AB1, —; AB2, — Solder, brazing, BS1945, 3s. 0½d. lb.; granulated, 3s. 4d. lb.

* Average 68-70 per cent.